Spring 5-1954

Southwestern Extension of the Pondera Field

Paul P. Garding

SOUTHWESTERN EXTENSION

OF THE

PONDERA FIELD

by
Paul P. Garding

A Thesis
Submitted to the Department of Geology
in Partial Fulfillment of the
Requirements for the Degree of
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TABLE OF CONTENTS

	Page
Abstract	1-A
Introduction	1
Location of area	1
Purpose	2
Acknowledgments	2
Summary of previous work	3
The Southwest Extension	
Location and description	5
History	5
Geology	8
Physiography	8
Stratigraphy	12
Description of formations	13
Cambrian	14
Ordovician	17
Silurian	17
Devonian	17
Mississippian	18
Pennsylvanian	20
Permian	20
Triassic	20
Jurassic	20
Cretaceous	21
Structure	27
Oil Occurrence	27
Economic Products	28
Summary	29
Conclusions	29
Bibliography	31

Additional material, such as: electric log of area discovery well, and scout cards for the Texas Company wells have been placed in a pocket on the inside of the back cover. (Original manuscript only).

ILLUSTRATIONS

		Page
Plate 1	Index map of Montana.	4
Plate 2	Topographic map of the Southwest Pondera area.	9
Plate 3	Lessor's map of area, showing well locations.	10
Plate 4	Stratigraphic Section for the Sweetgrass Arch, Montana.	15
Plate 5	Composite log section for Pondera Oil Field.	16
Plate 6	Isopach maps of Cambrian, Ordovician, Devonian and lower Mississippian systems.	23
Plate 7	Isopach maps of Upper Mississippian and Pennsylvanian.	24
Plate 8	Isopach map of Permian.	25
Plate 9	A. Distribution of Triassic strata. B. Isopach map of Jurassic Ellis.	26
Plate 10	Montana's Annual Oil Production, by Fields.	30

Figure 1	Structural contour map on surface of Madison limestone.	11

SOUTHWESTERN EXTENSION
OF THE
PONDERA FIELD

ABSTRACT

Oil was discovered in the Pondera field in June 1927 following work done by E. B. Emrick. The initial discovery well, located in section 17, T. 27 N., R. 4 W., was not a commercial oil producer. Its initial production being 3 barrels of oil and 3,500,000 cubic feet of gas per day. Rapid expansion followed until 1929, when the field reached its peak of production.

The limits of the field were thought to be well defined by 1940, but beginning in 1948 and continuing through the years that followed, the limits were extended considerably. It was during 1950 that the Phillips Petroleum Company began drilling operations to the southwest of the main pool in an area previously untested. It was through these efforts that the area of southwest Pondera was discovered and brought into production. The discovery well had an initial production of 25 barrels of oil and 132 barrels of water per day. To date there are 14 oil producing wells in the area and 1 gas well, that had an initial flow of 200 million cubic feet of gas per day.

The limits of the extension seem to be well defined at

the present time. The word extension as used in this paper, covers only the 4 sections in the southwestern corner of T. 27 N., R. 4 W..

INTRODUCTION

The Pondera oil field lies approximately 30 miles south of the Kevin-Sunburst field and about 6 miles southwest of the town of Conrad, in Teton and Pondera Counties, Montana. (See Plate 1: p. 4). The field, straddling the county line, lies on a glaciated, level, treeless plain. The productive portion of the field encompasses an area of approximately 6 square miles, and its greatest dimensions are 3 miles by 5 miles across. (Perry, 1953: p. 29-30)

The thesis area, lying from 1 to 2 miles southwest of the main Pondera field, is located in sections 29, 30, 31 and 32, T. 27 N., R. 4 W.. (See Plate 1: p. 4 and Figure 1: p. 11). A variety of names have been applied to this area,[1] but for the purposes of this paper, the title: "Southwestern Extension of the Pondera Field", will be used.

The discovery well for the main Pondera pool was drilled in the center of the SE-1/4, SE-1/4, sec. 17, T. 27 N., and R. 4 W., by the Montana Pacific Oil Company and was completed in June 1927. (See Figure 1: p. 11). Rapid expansion followed; until by 1940, the limits of the producing area were thought to be well defined, but beginning with 1948, and particularly

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1. The area has been variously called: Pendroy Pool, West Pondera, and Southwest Pondera, but as stated above, the name applied by the Montana Oil and Mining Journal will be the one used throughout this paper.

during 1950 and 1951, the limits of the field were extended considerably.[2] It was during the year 1950, that the Phillips Petroleum Company started drilling to the southwest of the main pool in an area here-to-fore believed to be dry. The information derived from this work led to the "discovery of a buried hill structure" in sections 29, 30, 31 and 32, in T. 27 N., R. 4 W.. The interesting possibilities presented by the existence of such a structure, and the absence of any published reports on the area, were the main reasons for choosing the locality for thesis material. Field work was neither contemplated nor attempted, outside of visiting the offices of the Montana Oil and Gas Commission at the State Capitol to consult their files. The main problems being essentially the compilation and sifting of information, and the setting forth of the data under one cover.

Acknowledgments

It is at this point that the writer wishes to acknowledge the aid and cooperation given to him by: Dr. Blake and Mr. J. B. Flugstad of the Montana School of Mines, Mr. J. E. Blixt of the Texas Company, and Mr. J. W. Nordquist of the Phillips Petroleum Company.

In particular, the writer wishes to thank Dr. O. D. Blake for his constructive criticism and for the invaluable guidance

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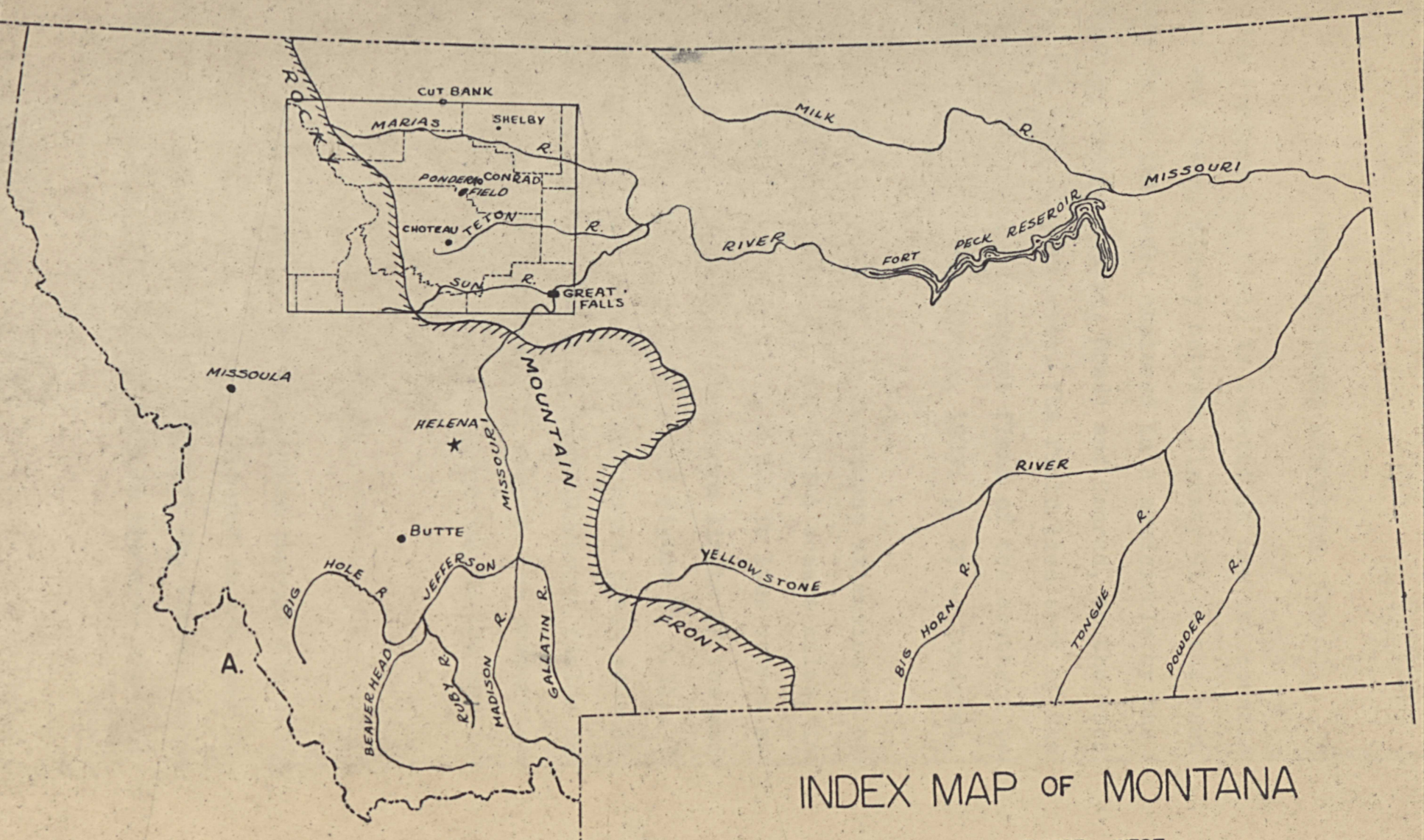
2. For a more detailed account of the history of the area, turn to the section dealing with that particular subject.

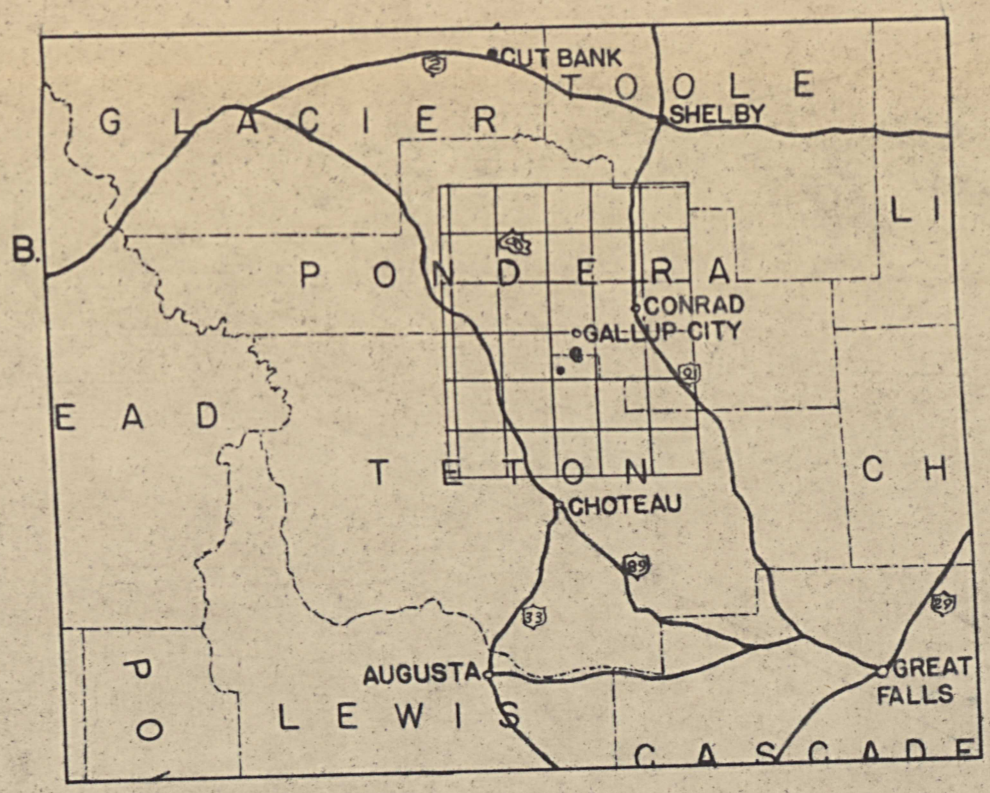
and information he has given during the compilation of this thesis.

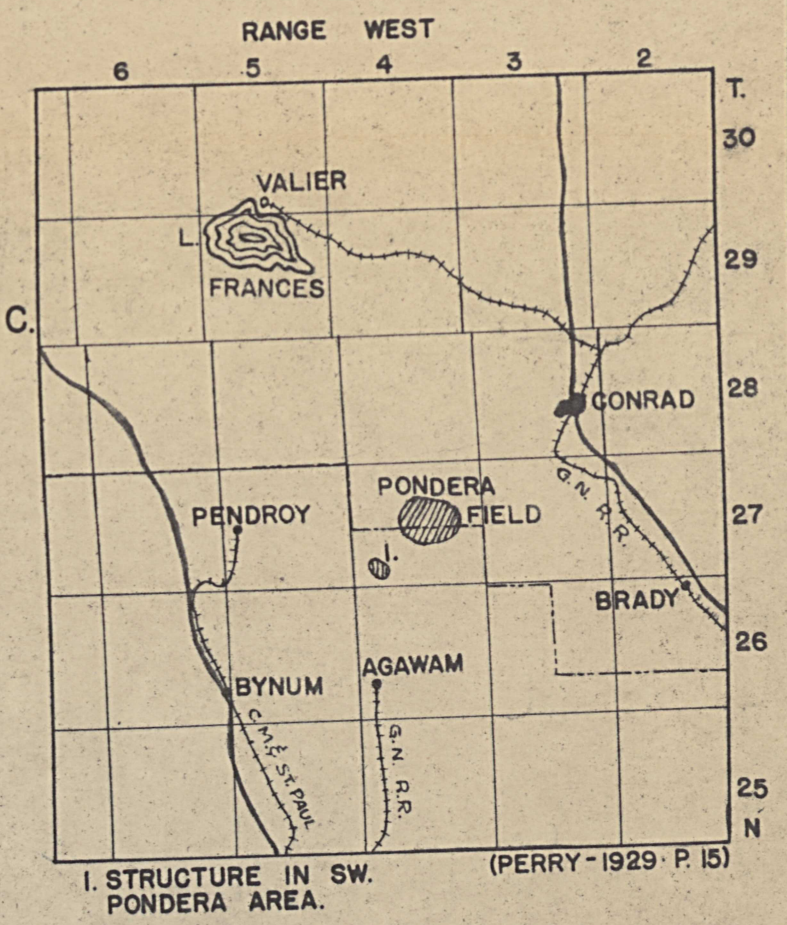
Summary of Previous Work

Previous work on the thesis area is very sketchy, and at best, very limited in scope. No written reports were available, outside of a brief mention by Perry (1953: p. 29-30) and an U. S. G. S. map of the area compiled by C. E. Erdmann and K. H. Holmes (1952). The thesis material was compiled largely from data obtained from the files of the Montana Oil and Gas Commission, and from information supplied by Mr. J. E. Blixt, Senior Geologist, Texas Company, and by Mr. J. W. Nordquist, Assistant District Geologist, Phillips Petroleum Company. The background material for the thesis was obtained from the various reports and articles that are listed in the bibliography.

INDEX MAP OF MONTANA







I. STRUCTURE IN SW. PONDERA AREA.

(PERRY - 1929 - P. 15)

A. INDEX MAP SHOWING LOCATION OF GENERAL AREA.

B. GENERAL AREA SHOWN IN GREATER DETAIL.

C. MAP OF AREA SHOWING LOCATION & RELATIONSHIP OF STRUCTURE WITH RESPECT TO THE MAIN PONDERA FIELD.

THE SOUTHWEST EXTENSION

The Pondera oil field is located in the two counties of Pondera and Teton, midway between Highway 91 on the east and Highway 89 on the west; enclosed in a semicircle by the towns of Pendroy, Bynum, Agawam, Brady and Conrad, to the west, south, and east respectively. The field lies east of the Rocky Mountain front on the northwest flank of the southern portion of the Sweetgrass Arch. (Perry, 1929: p. 23 -- Lundgren, 1939: p. 57).

The producing area of the southwest extension is contained in 4 sections (29, 30, 31 and 32); 4 square miles, in the southwest corner of T. 27 N., R. 4 W.. It lies approximately 1-1/2 to 2 miles from the southwestern limits of the main Pondera pool. (Note Plate 1: p. 4 and Figure 1: p. 11). The extension is situated on a level glaciated plain some 30 odd miles south of the Cut Bank and Kevin-Sunburst fields and about 6 miles to the southwest of Conrad. The productive portion of the field can be seen by referring to the map (Plate 3) on page 10.

History

The field (Pondera) was discovered through the efforts of E. B. Emrick, who first became interested in the area in 1922 while in the employ of a major company. Mr. Emrick resigned his position so as to continue work in the area when the com-

pany failed to drill a test upon his recommendation. The first test well was drilled in 1926, but as only residuary oil was found, another test was planned. Utilizing the information gained from the first test, Mr. Emrick spotted the location which proved to be the discovery well for the Pondera field. (Platt, 1928: p. M-14).

The discovery well was drilled in the center of the SE1/4, SE1/4, sec. 17, T. 27 N., R. 4 W., by the Montana Pacific Oil Company and was completed in June 1927. This well produced 3 barrels of oil and 3,500,000 cubic feet of gas per day on test. Though not a commercial oil well, it served to stimulate drilling activity in the area. Within a year 8 more wells had been drilled and initial production varied from 50 to 200 barrels of oil per day. By February 1, 1929, 89 producing wells had been drilled. The year 1929 proved to be the fields best with a total production of 977,000 barrels of oil. (See plate 10: p.). By 1935, 153 producing wells had been drilled, and some 15 of these had initial flows of gas amounting from 1 to 5 million cubic feet per day.

The limits of the field were believed to be well defined by 1940, when Lundgren (1939: p. 57) wrote as follows:

> "Production in the Pondera field is gained in ... the Madison limestone ... producing only from its extreme top. South of the producing area the upper 15 to 25 feet of this limestone is tight and barren. It

appears that the closure to the south of the terrace (Pondera structure) is due therefore to lack of porosity."

Test wells continued to be drilled. Beginning with 1948, and particularly during the years following, important extensions to the field were discovered to the northwest, northeast and south. The original producing area was greatly enlarged as can readily be seen by noting that there were 254 wells in the area by December 1950. (Perry, 1953: p. 29-30).

In 1950, the Phillips Petroleum Company decided to drill 4 stratigraphic test wells to the southwest of the main field in a previously untested area. The first well, Phillips State No. 1, was spudded in January 1950, in the NW-1/4, NE-1/4, SW-1/4, sec. 36, of T. 27 N., R. 5 W.. This well proved to be dry and was plugged and abandoned. The second test well, situated 1 mile northeast of the failure and 2-1/2 miles southwest of the Pondera discovery well, was the Phillips Freda Johnson No. 1 and was located in the NE-1/4, NW-1/4, NE-1/4 of sec. 31, T. 27 N., R. 4 W.. This well, spudded in February 1950 and completed in May 1950, had an initial production of 25 barrels of oil and 132 barrels of water per day. The discovery spurred activity in the area so that by the end of 1950, 4 wells had been drilled in the vicinity; of these one was dry. By 1953, 21 wells had been drilled in the 4 sections (29, 30, 31 and 32) and 3 outlying wells had been put through to the producing zone. Of these 24 wells; 6 were dry, 1 was dry with a

show of gas, 1 was a gas well, and 16 were oil producers. The initial production of these wells ranged from 20 to 120 barrels of oil and 4 to 132 barrels of water per day. (See Plate 3: p. 10).

It was during March of 1950, that it was announced in various publications[3] that the oil bearing structure in the area was "an unnamed 'buried hill' pool". (Larson, 1951: p. 296. See footnote below.). Most accounts credit C. E. Erdmann of the U. S. Geological Survey for the recognition of the structure in the area. (See Figure 1: p. 11). This feature does not exist; as one can readily see by referring to Plate 3, p. 10, the top of the Madison limestone occurs in a structural position of approximately the same elevation.[4]

GEOLOGY

Physiography

The terrain in the area is like that of the main Pondera pool, in that it is a treeless prairie, cut by coulees formed by the spring run-off of water. (See Plate 2: p. 9). The ground elevation rises gradually as one progresses to the west

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3. One account in particular, that the writer was able to read, was in "Statistics of Oil and Gas Development and Production", Petroleum Branch, A. I. M. E., v. 6, covering 1951, pp. 296-297.

4. This contention was concurred in by Mr. J. W. Nordquist, Assistant District Geologist of the Phillips Petroleum Company, Billings, Montana, in a personal communication with the writer.

R. 5 W.

R. 4 W.

TOPOGRAPHIC MAP
OF THE
SOUTH-WEST PONDERA AREA

SCALE: 1" = 1/2 MILE

CONTOUR INTERVAL = 25'

+4021 FOUND CORNER WITH ELEVATION

INTERMITTENT STREAM

• DENOTES WELLS ON OR NEAR STRUCTURE

X BM 4047 USGS BENCH MARK

PLATE Nº 2

PONDERA COUNTY
TETON COUNTY

MAUCKI COULEE

FARMERS COULEE

BM X 4161

BM X 4047

4172 4123 4085 4055 4021

4064 4034 3992 3968 3948

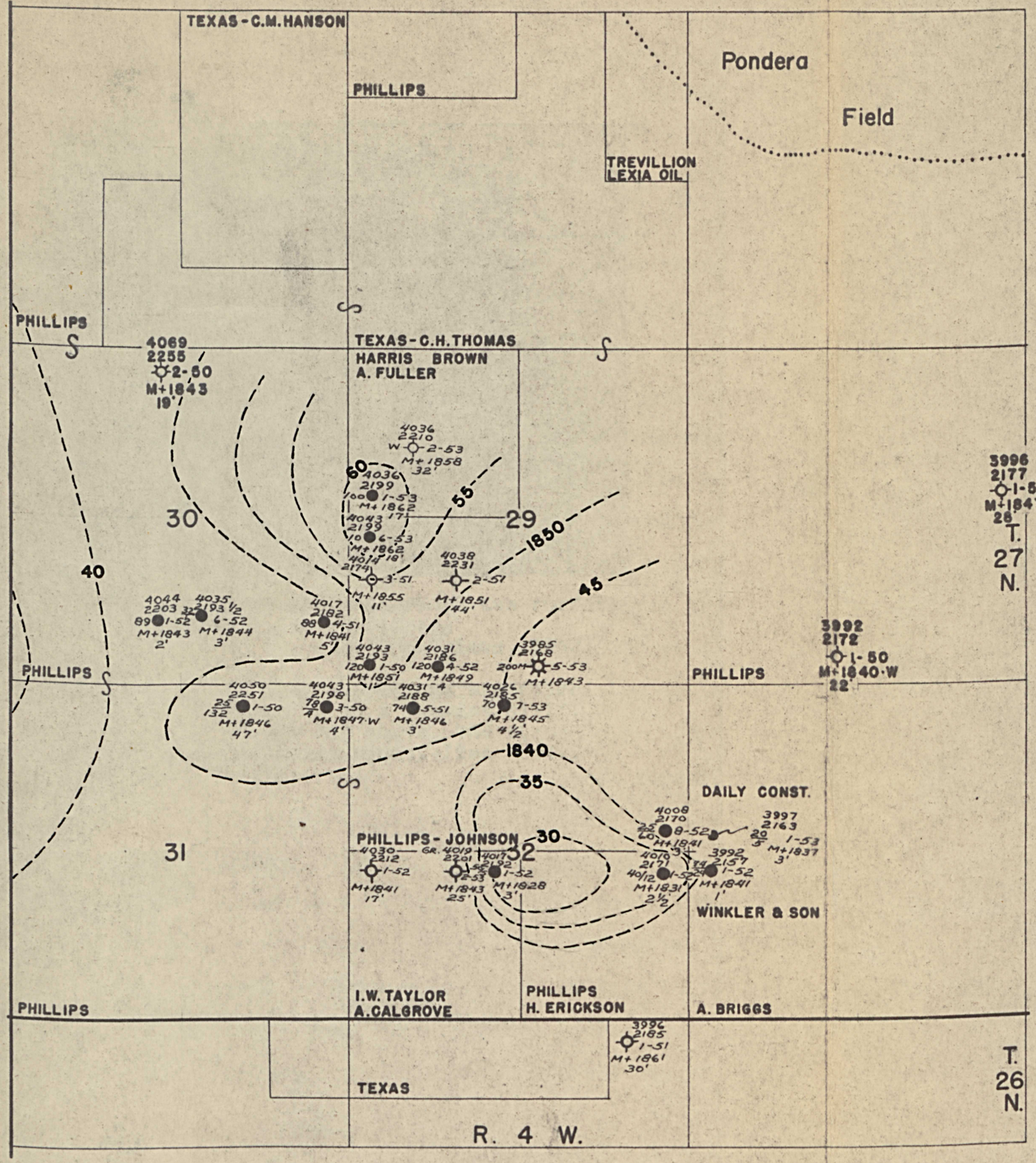
4081 4002 4020 3991 3962

3958 4044 3963 3954 3926

T. 27 N.

T. 26 N.

ADAPTED FROM: USGS TOPOG. MAP - GALLUP CITY QUADRANGLE (1936-38) 15 MIN. SERIES



LEGEND

WELL SYMBOLS

- OIL
- DRY HOLE
- SHOW OF GAS
- GAS

D.F. ELEVATION ~ 4043
INITIAL PRODUCT'N 2193 ~ TOTAL DEPTH
BBLS OIL / DAY ~ 40
BBLS WTR/DAY ~ 12
1-50 · WELL NO. & YEAR COMP.
M+1831 · MADISON STRUCTURAL ELEVATION
5' DEPTH MADISON PENETRATION

SHOWING
CONTOURS ON THE SURFACE OF THE MADISON LIME (PRODUCING HORIZON).

BASE MAP OBTAINED FROM:
THE TEXAS COMPANY
COURTESY OF:
J.E. BLIXT

PLATE 3

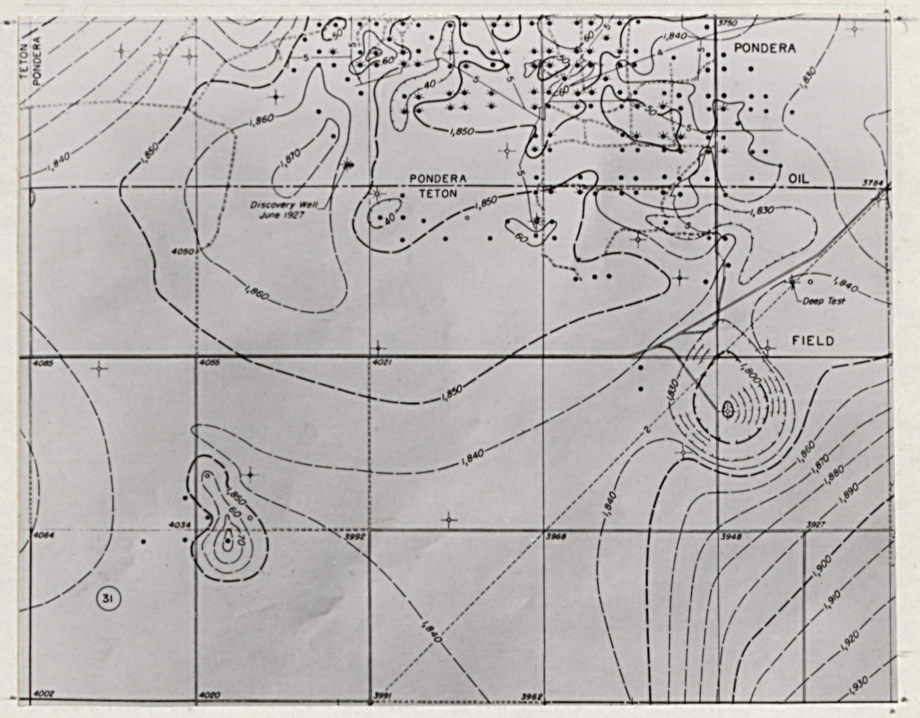


Figure 1. Structure Contours on the surface of the Mississippian limestone.
(Erdman-Holmes, 1952)

This figure shows the prominant structure which was supposed to be a "buried hill". Though shown in the map above, the structure is actually nonexistent. (See text).

and north. The area, as can be noted from the topography, is divided almost equally by the east-west trending Maucki Coulee. The entire section is over-lain by glacial drifts.

Stratigraphy

Immediately underlying the surface soils and the Pleistocene glacial drifts in the area, are the shales of the Colorado group of the Cretaceous period. (Note Plates 4 and 5: pp. 15 and 16). The glacial drifts vary in thickness from about 18 to 35 feet in the area, and rest unconformably on the Colorado group. The thickness of the Colorado varies from 1400 to 1560 feet, as interpreted from the various drillers logs and formation tops as listed by the various companies operating in the area. In the composite log for the Pondera field (Plate 5), as given by Erdmann, the thickness is approximately 1290 feet. Perry (1953: p. 30) lists the thickness as being 1200 to 1400 feet.

The Colorado rests conformably on the Kootenai formation, the thickness of which varies from 425 to 490 feet. About 40 feet of Sunburst sandstone marks the base of Kootenai, which lies unconformably on the underlying Morrison formation. The thickness here varies from 80 to 100 feet. The underlying 190 to 220 feet of the Ellis is divided into the 185 foot thick Swift sandstone and the 20 foot thick Rierdon limestone. A disconformity marks the base of the Rierdon and the top of the

Madison limestone of Mississippian age. The extreme top of the Madison is the producing horizon of the entire Pondera area. No wells to date have penetrated through the Madison to greater depth.

Perry (1953: p. 30) states that the total thickness of the Madison is about 1150 feet and that the base is marked by about 50 feet of dense, grayish-green shale of Devonian age. These shales overlie about 800 feet of the Potlatch anhydrite formation. Beneath the Potlatch formation lies 250 feet of Jefferson limestone followed by approximately 110 feet of the Maywood formation at the base of the Devonian. The total thickness of the underlying Cambrian strata ranges around 760 feet and consists of: 100 feet of shale (Dry Creek formation); 100 feet of dolomite of the Pilgrim formation; 550 feet of undifferentiated shales; and finally, at the base, a sandstone (Flathead formation) approximately 20 feet in thickness. Granitic rocks of the Pre-Cambrian underlie the sediments.

Description of the Formations

The reader is requested to refer to Plates 6, 7, 8 and 9, at the end of this section for isopach and distribution maps of the various formations described herein.

Cambrian

The standard classification used in western Montana consists of six formations; which, from the top down are as follows:[5]

Dry Creek (Red Lion)	reddish sandy shales with some limestone.
Pilgrim	massive, mottled dolomite.
Park	fissile, green shales.
Meagher	mottled limestone or dolomite.
Wolsey	fissile, green, sandy shales.
Flathead	pink quartzite and coarse sandstone.

The total thickness of the Cambrian strata near the Rocky Mountain front is about 2000 feet, but this thins out progressively to the east. In the Pondera area the thickness averages about 755 feet according to Erdmann (1952).

The Cambrian consists of about 15 feet of the Flathead at its base directly overlying Pre-Cambrian granites. The Flathead, made up of fine-grained sandstone and quartz, is calcareous near its top and progressively more quartzitic towards its base. Overlying the Flathead conformably is an undifferentiated shale which is in the order of 545 feet in thickness. This shale, maroon to grayish-green in color, is

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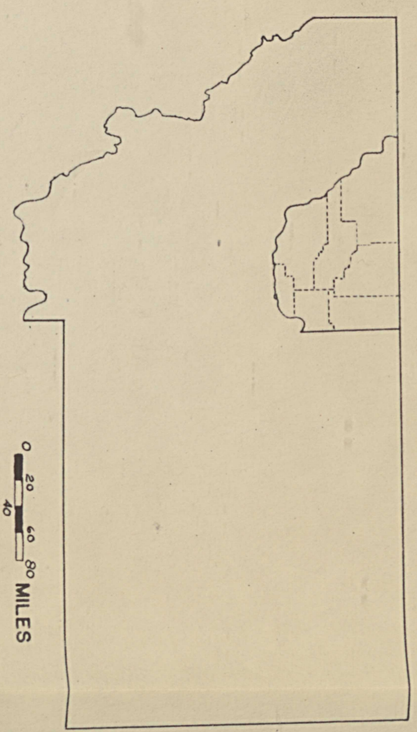
5. After Perry, 1953: p. 15.

AGE	PERIOD	EPOCH	SWEETGRASS ARCH
CENOZOIC	QUATERNARY	PLEISTOCENE	ALLUVIUM
			LAKE BEDS
			GLACIAL DRIFT
			TERRACE GRAVEL
	TERTIARY	PLIOCENE	
			FLAXVILLE GRAVEL ?
		MIOCENE	
		OLIGOCENE	
		EOCENE	
		PALEOCENE	
MESOZOIC	CRETACEOUS	GULFIAN	WILLOW CREEK FM.
			ST. MARY RIVER FM.
			HORSETHIEF SST.
			BEARPAW SHALE
			TWO MEDICINE FM.
			EAGLE SST.
			VIRGELLE
			COLORADO SHALE
			BLACKLEAF MEMBER
		COMANCHIAN	KOOTENAI FM.
			"SUNBURST SAND"
	JURASSIC	OXFORDIAN	
			ELLIS
	TRIASSIC		
PALEOZOIC	PERMIAN		
	PENNSYL.	DES MOINES	
	MISSISSIPPIAN	CHESTER	
		MERAMEC	
		OSAGE	
		KINDERHOOK	MADISON LST.
	DEVONIAN	CHAUTAUQUAN SENECAN	THREE FORKS FM.
		ERIAN ULSTERIAN	JEFFERSON DOL.
	ORD.	RICHMOND	
	CAMBRIAN	CROIXAN	CAMBRIAN UNDIFFERENTIATED
		ALBERTAN	
			FLATHEAD QTZITE
PROTEROZOIC		BELTIAN	



MONTANA

AREA REPRESENTED BY THE COLUMN ON THE LEFT IS SHOWN IN THE MAP ILLUSTRATED ABOVE.

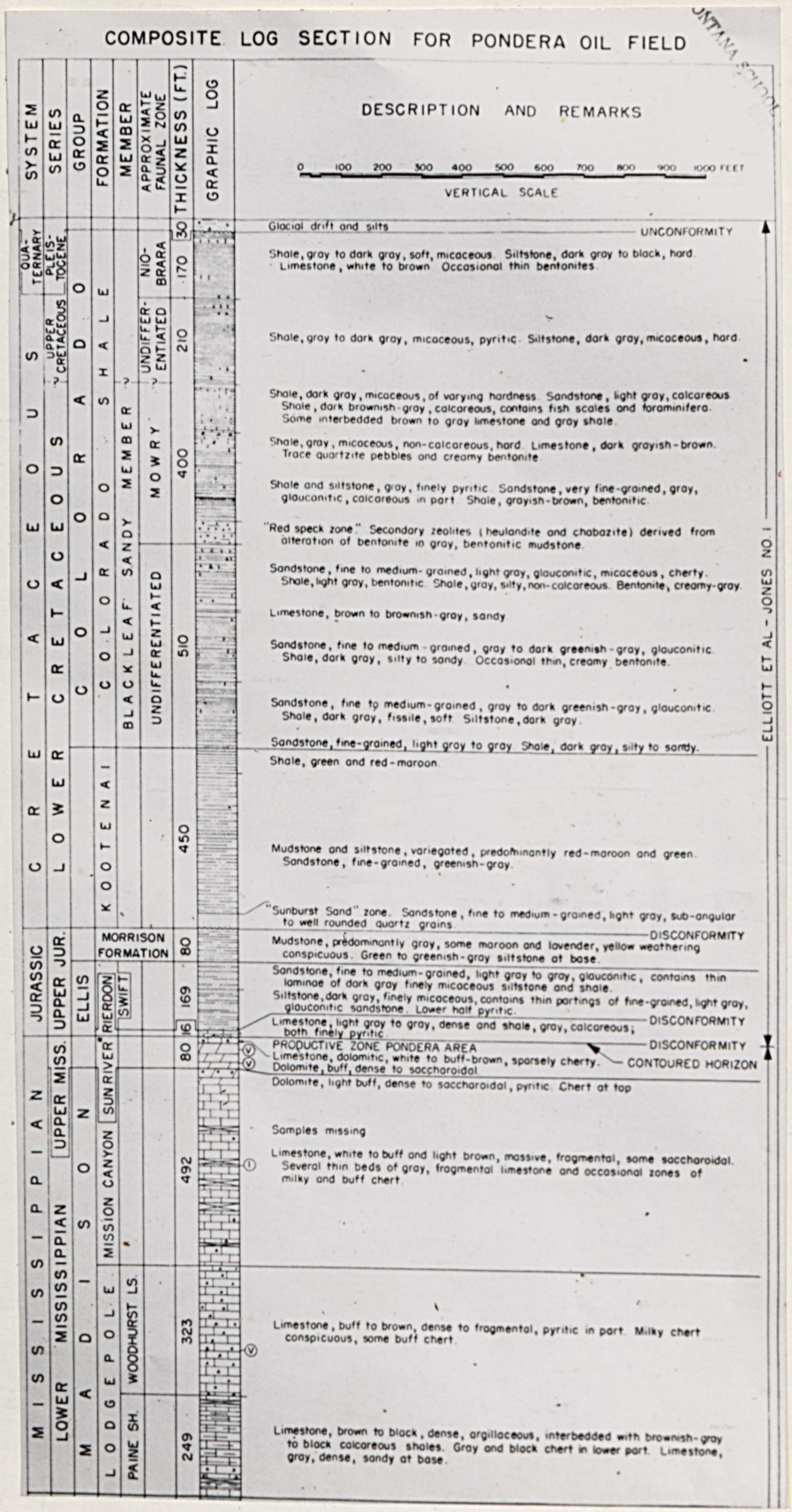
QUOTATION MARKS INDICATE TERMS WHICH ARE OBSOLETE OR NOT IN GENERAL USE.

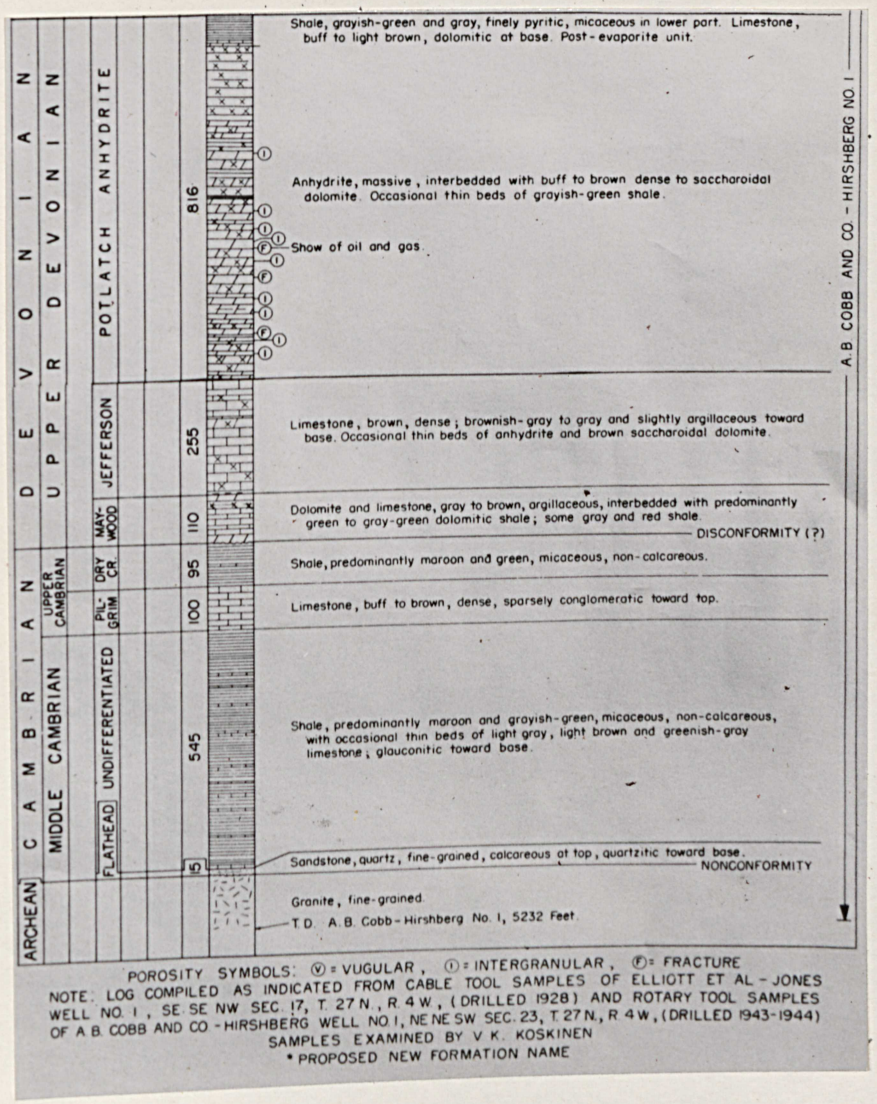
STRATIGRAPHIC SECTION FOR THE SWEETGRASS ARCH, MONTANA

PLATE Nº 4

(PERRY-1945)

COMPOSITE LOG SECTION FOR PONDERA OIL FIELD





POROSITY SYMBOLS: Ⓥ = VUGULAR, Ⓘ = INTERGRANULAR, Ⓕ = FRACTURE

NOTE: LOG COMPILED AS INDICATED FROM CABLE TOOL SAMPLES OF ELLIOTT ET AL - JONES WELL NO. 1, SE. SE NW SEC. 17, T. 27 N., R. 4 W., (DRILLED 1928) AND ROTARY TOOL SAMPLES OF A.B. COBB AND CO - HIRSHBERG WELL NO 1, NE NE SW SEC. 23, T. 27 N., R. 4 W., (DRILLED 1943-1944)

SAMPLES EXAMINED BY V.K. KOSKINEN

* PROPOSED NEW FORMATION NAME

from- Erdman & Holmes- 1952.

PLATE No. 5

micaceous, non-calcareous and contains occasional partings of limestone. It is glauconitic towards its base. The Pilgrim, the next formation in order, is a dense, buff to brown colored limestone, which is slightly conglomeritic near its top. The thickness of the Pilgrim is approximately 100 feet. The top of the Cambrian in the area is marked by 95 feet of Dry Creek (Red Lion) shale, which is micaceous, non-calcareous and predominantly maroon and green in color.

No oil or gas has been found in the Cambrian of the area and the possibility of oil occurring in the strata is unlikely as the formations have yet to be productive in Montana.

Ordovician and Silurian

Ordovician and Silurian strata seem to be absent throughout the Sweetgrass Arch area. Therefore, no description will be attempted here.

Devonian

The strata in the Pondera field area is designated as being upper Devonian in age and consists of: the Maywood formation at the base unconformably overlying the Cambrian; the Jefferson formation; and last, the Potlatch anhydrite at the top of the sequence.

The Maywood, 110 feet in thickness, is a dolomite and limestone interbedded with green to grayish-green shales. It

is argillaceous and gray to brown in color. The Jefferson limestone is dense and brown in color near its top, brownish-gray and slightly argillaceous towards its base. The overlying 816 feet of Potlatch anhydrite is marked by a grayish-green shale at its top. The lower part of this shale is micaceous and finely pyritic. A buff to light brown, dolomitic limestone occurs at the base of the shale (Post-evaporite unit). This is underlain by a massive anhydrite sequence which is interbedded with dense, brownish dolomite and occasional thin partings of shale.

Some showings of oil and gas have been reported in the Potlatch formation of the main Pondera pool, but as yet, it remains to be tested in the southwest extension.

Mississippian

The strata of Mississippian age lie conformably on the Devonian. The thickness is reported to range from 1140 to 1150 feet. The lower 249 feet are listed as the Paine shale member of the Lodgepole formation by Erdmann (1952). (See Plate 5: p. 16). The Paine member is a dense, argillaceous, brown to black limestone with interbedded calcareous shales. The lower part contains gray and black chert with a dense, gray, sandy limestone at the base. Above the Paine lies 323 feet of the Woodhurst limestone member of the Lodgepole. This member is dense to fragmental, brown in color, and contains conspicu-

ous milky chert. (Plate 5: p. 16).

The Mission Canyon overlies the Lodgepole formation and has a thickness of about 492 feet according to Erdmann (1952). The upper portion is a pyritic, dense to saccharoidal, light colored dolomite. The top of this dolomite is cherty. The lower portion of the Mission Canyon is a fragmental, massive, white to brown limestone containing occasional zones of milky and buff chert.

Erdmann classifies the productive portion into the upper Mississippian and proposes a new formation name, "Sunriver", for this zone. He assigns a total thickness of 80 feet to this section. The upper portion is a sparsely cherty, white to browmish, dolomitic limestone and underlying this is a buff colored, saccharoidal dolomite.

The preceeding descriptions are from the work of Erdmann (Plate 5: p. 16). Most accounts do not attempt to classify the Madison, merely being content to report the productive zone as being in the upper part of the Madison, of lower Mississippian age.

The structural position of the top of the Madison is approximately of the same elevation. The elevation of the surface (datum mean sea level) varies from 1828 feet to 1862 feet. (Refer to Plate 3: p. 10). It is for this reason that the idea of a "buried hill" structure as shown in Figure 1 on page 11 has been rejected by the writer.

Strata of Pennsylvanian, Permian and Triassic ages are absent throughout the entire Sweetgrass Arch, and will not be discussed in this paper. (Note Plates 7,8 and 9 at the end of this section.).

Jurassic

Lower and middle Jurassic strata are missing in the area, as is the Sawtooth member of the Ellis group. A disconformity exists between the Rierdon limestone, base member of the Ellis, and the underlying Madison limestone. In the main Pondera pool, according to Erdmann (1952), the Rierdon limestone has an average thickness of 16 feet. Perry (1953: p. 30) lists the thickness as being about 20 feet. The Phillips Petroleum Company lists the thickness of the Rierdon in the southwest extension as being approximately 30 feet. The Texas Company, on the other hand, lists it as being a hard, black limestone, 102 feet thick, in its C. H. Thomas No. 1.[6] (SW,SW,SW, sec. 29). (See Plate 3: p. 10). Erdmann (Plate 5: p. 16) describes the Rierdon as follows:

> "Limestone, light gray to gray, dense and shale, gray, calcareous; both finely pyritic."

---

6. The variations in the given thicknesses of formations and members is due to the variety of marker horizons used by different persons as tops. It seems that no two people will pick the same horizon for a marker bed to determine formation tops.

Overlying the Rierdon disconformably is the Swift formation, also of the Ellis group. A composite log of 8 wells in the area gives the thickness as being about 162 feet. For the Pondera pool Erdmann lists the thickness at 169 feet. The upper portion consists of hard, gray, medium-grained sandstone with thin laminae of finely micaceous siltstone and shales; whereas, the lower portion is composed of dark gray, finely micaceous siltstone with thin partings of glauconitic sandstone. The Ellis group is overlain by mudstone and siltstone of the Morrison formation, which has a variable thickness of 80 to 87 feet. The mudstone is predominantly gray with maroon and lavender colorations, and weathers to a conspicuous yellow. The green to greenish-gray siltstones are to be found at the base of the Morrison.

Cretaceous

The overall thickness of the Cretaceous formations in the extension area is about 1920 feet. As given by Erdmann for the Pondera pool the thickness is about 1740 feet.

The basal member of the Cretaceous, the Kootenai formation, has an average thickness of about 450 to 465 feet. It consists of green and red-maroon shales near its top, variegated red-maroon and green mudstone and siltstone, with some greenish-gray sandstone in the central portion. The "Sunburst Sand" zone marks the base of the Kootenai and is about 40 feet

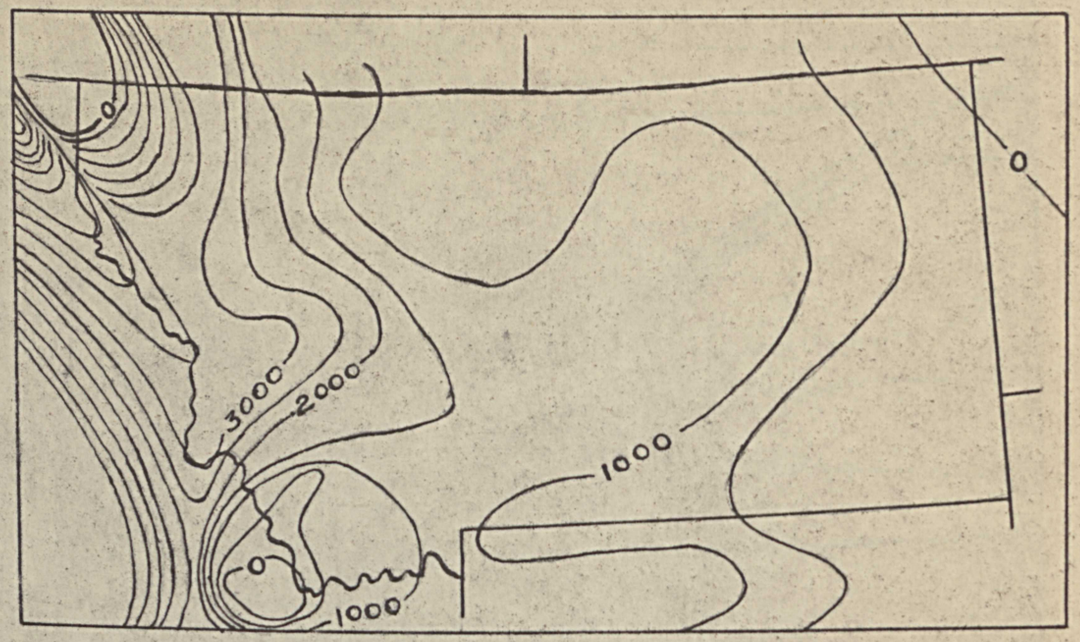
thick. (Perry 1953: p. 30).

Approximately 1455 feet of the Colorado shale overlies the Kootenai formation. The Blackleaf sandy member marks the base of the Colorado, and is about 820 to 910 feet thick in the area. No attempt has been made by the operators in the area to differentiate the Blackleaf into faunal zones as was done by Erdmann (1952). (See Plate 5: p. 16). The basal 500 feet are composed of fine to medium-grained, glauconitic sandstone, with some shales and bentonite. A sandy limestone appears in the upper portion.

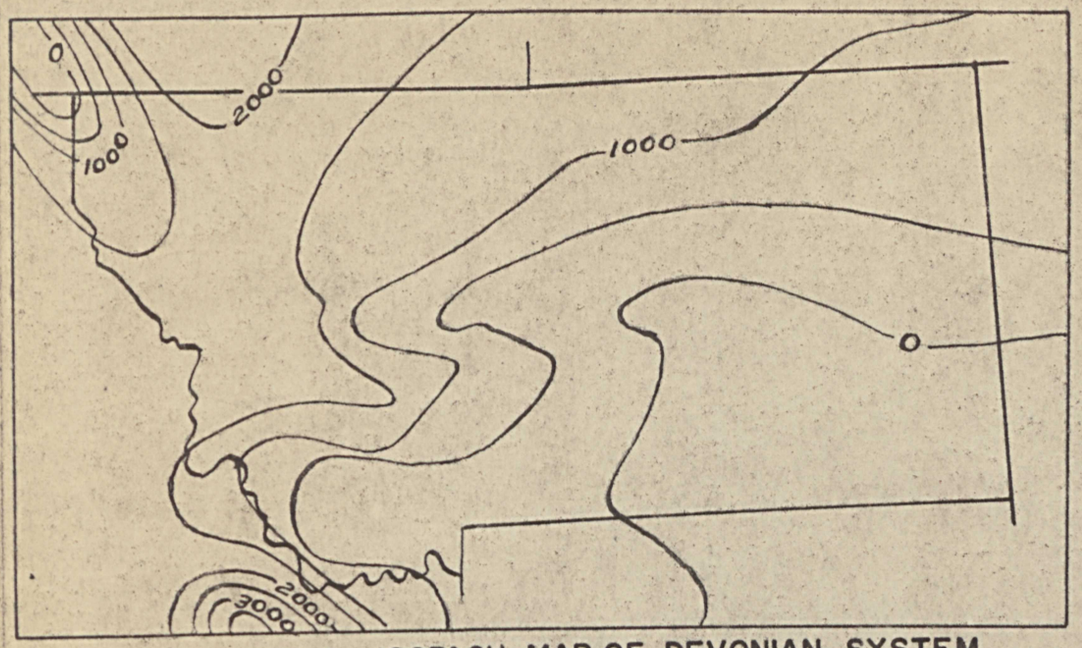
The upper 400 feet are composed mainly of gray to dark gray shales. The top shale bed contains a sandstone and is slightly calcareous and fossiliferous. The basal part is marked by the "Red Speck zone" (Erdmann, 1952) containing "secondary zeolites derived from the alteration of bentonite in gray, bentonitic mudstone".

The top 380 feet, commonly called the Colorado, consists of shales, with some limestones and siltstones. The beds are gray to dark gray in color, micaceous, and contain a few thin bentonites.

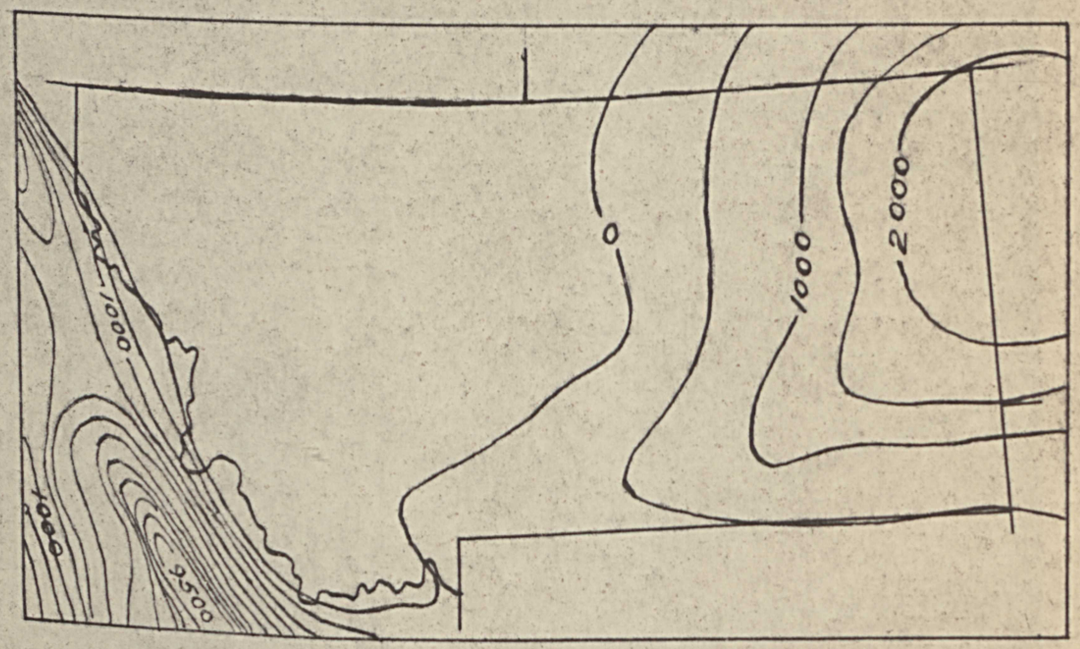
The Colorado group outcrops and forms the surface area of this section of the Sweetgrass Arch. The whole is overlain by Pleistocene glacial drifts.



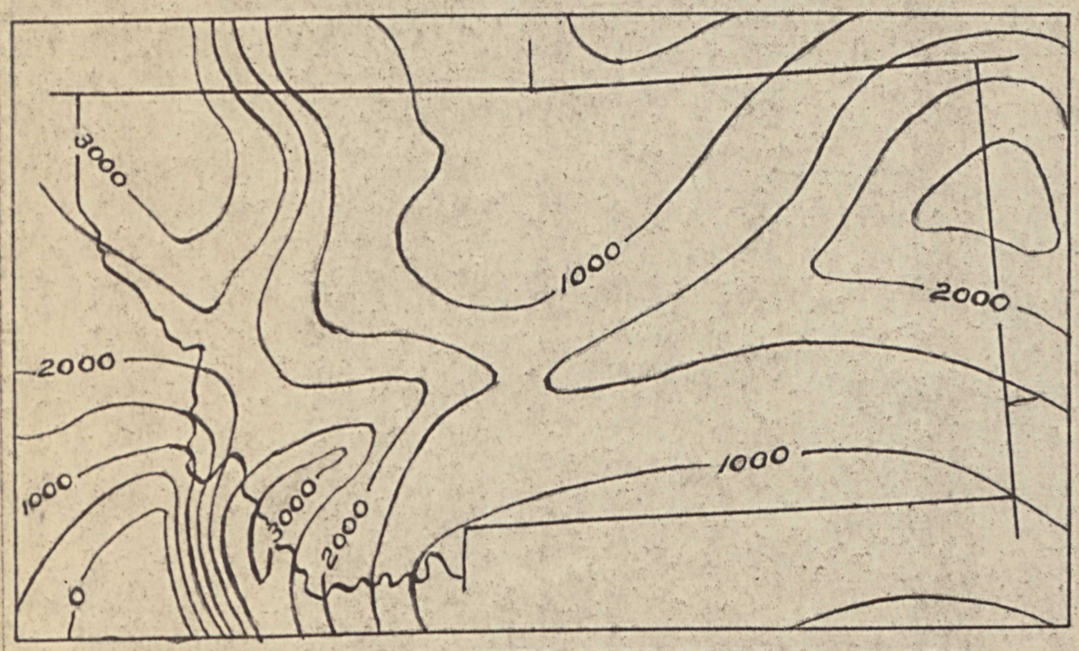
A. ISOPACH MAP OF CAMBRIAN SYSTEM



C. ISOPACH MAP OF DEVONIAN SYSTEM



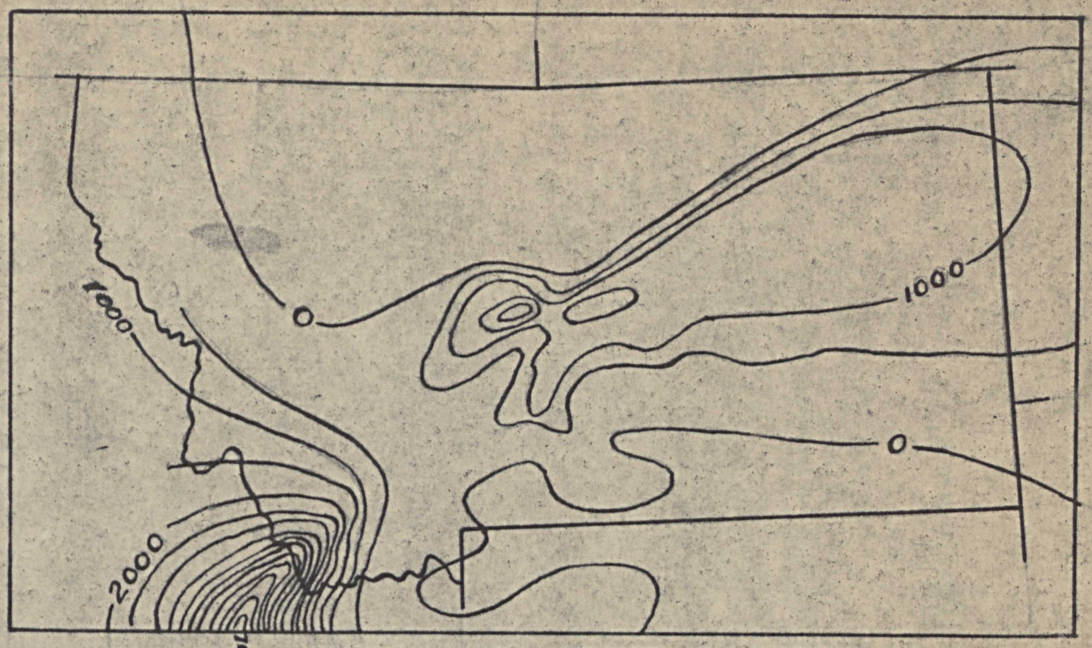
B. ISOPACH MAP OF ORDOVICIAN SYSTEM



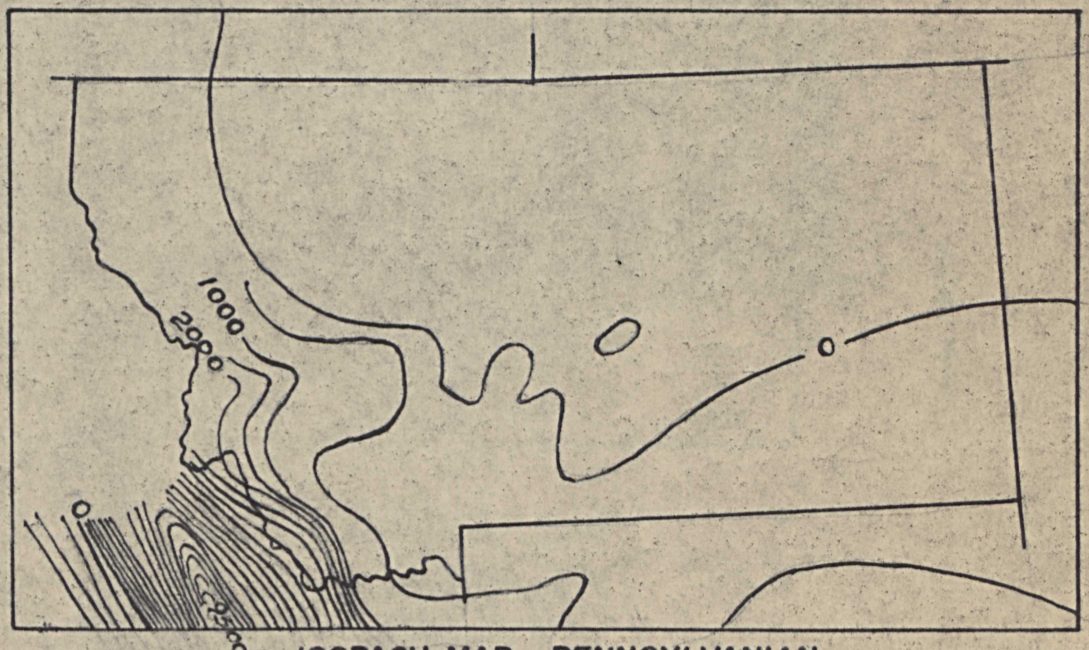
D. ISOPACH MAP OF LOWER MISSISSIPPIAN SYSTEM

PLATE No. 6

Sloss- 1950



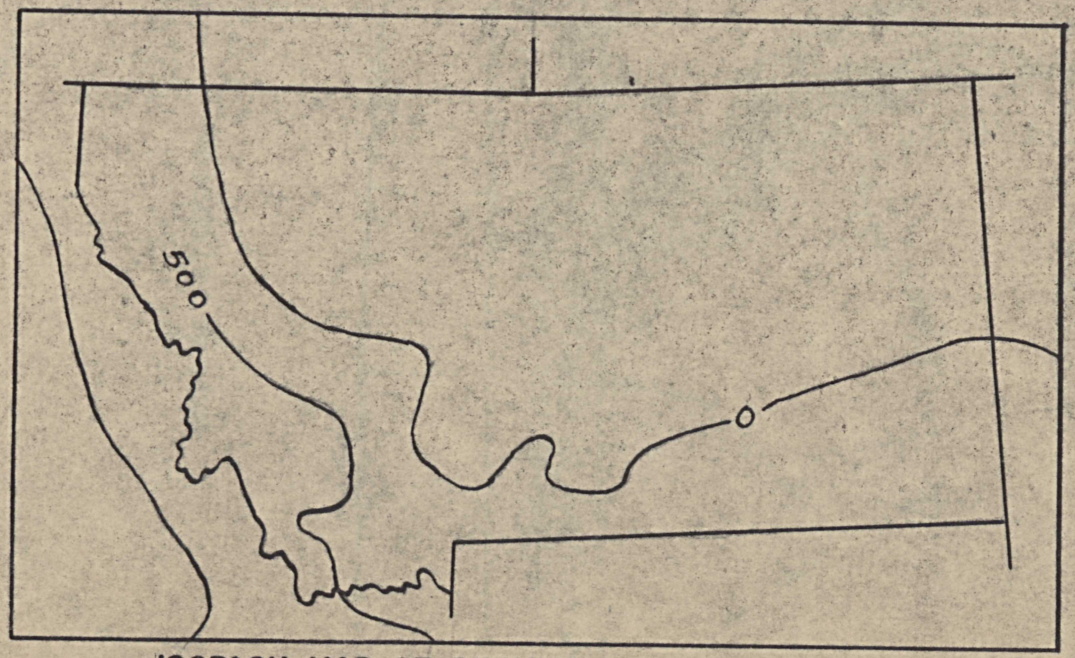
ISOPACH MAP- UPPER MISSISSIPPIAN



ISOPACH MAP- PENNSYLVANIAN

Sloss-1950

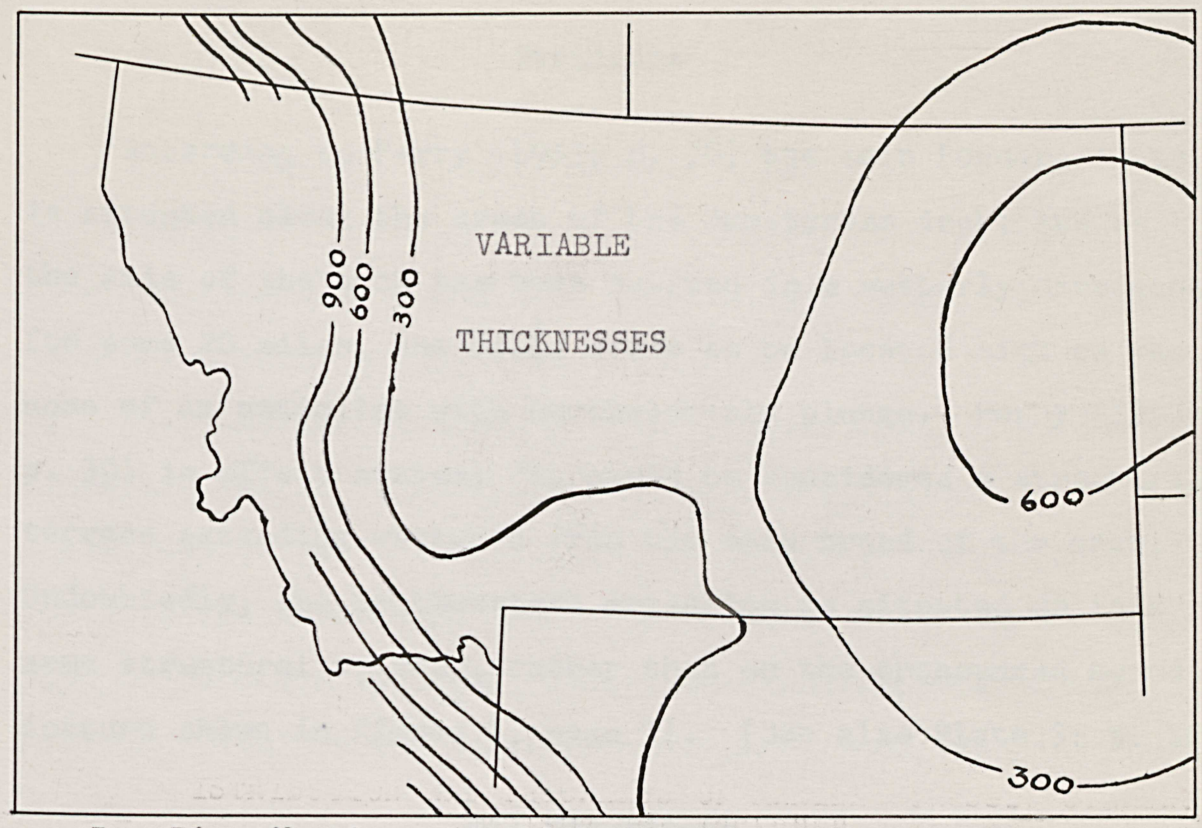
PLATE No. 7



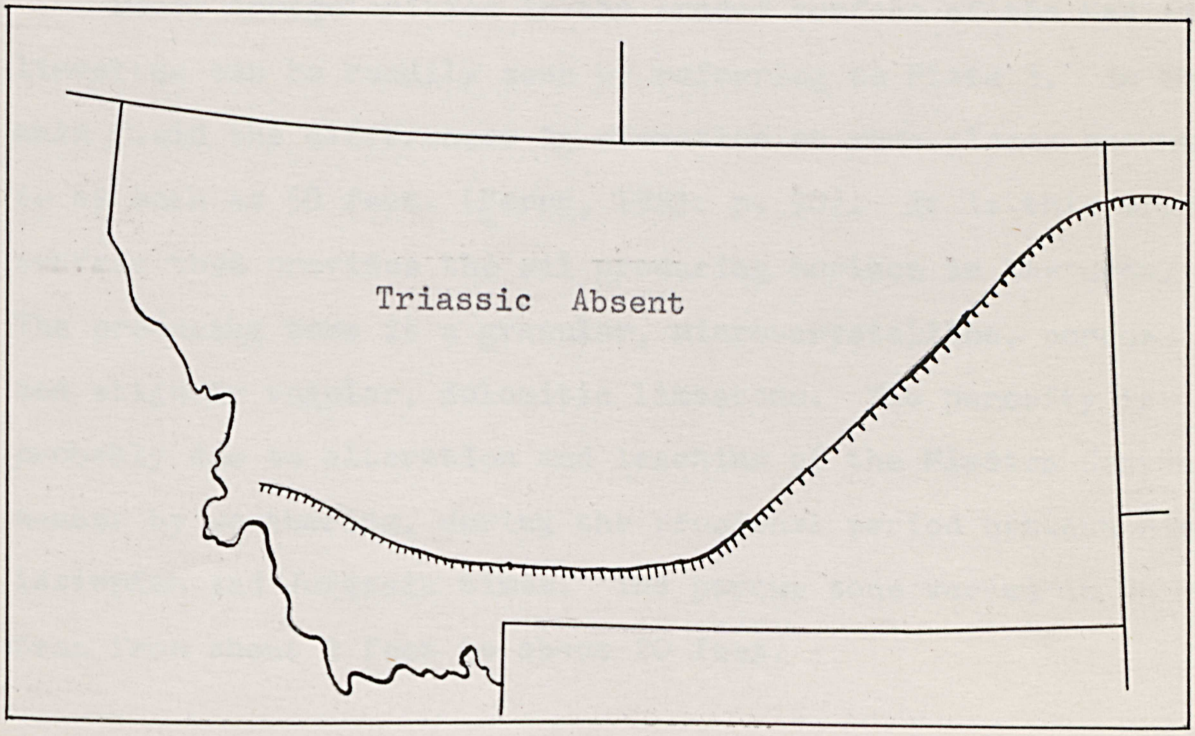
ISOPACH MAP OF PERMIAN

Sloss- 1950

PLATE No. 8



B. Distribution and thickness of marine Jurassic strata.
(Morrison not included)



A. Distribution of Triassic strata.

PLATE No. 9 (Perry, 1945)

Structure

According to Perry (1953: p. 30) the main Pondera field is situated along the crest of the Sweetgrass Arch; but as the axis of the arch has been shifted in a westerly direction for some 20 miles, the field seems to be located high on the nose of an anticline with northwesterly plunge. Perry (1953: p. 30) in effect states: "it could be considered a structural terrace extending westward from the main trend of the arch." Undoubtedly, the southwestern extension is situated on this same structural terrace, rather than on the pronounced mound feature shown in Figure 1, page 11. (See also Plate 3: p. 10).

Oil Occurrence

Local irregularities in the eroded surface of the Madison limestone can be readily seen by referring to Plate 3. In the main field the differences in elevation at some places amount to as much as 50 feet. (Perry, 1953: p. 30). It is this eroded surface that provides the oil producing horizon in the area. The producing zone is a granular, micro-crystalline, porous and slightly vugular, dolomitic limestone. The porosity is probably due to alteration and leaching of the Mission Canyon member by weathering, during the erosional period between Mississippian and Jurassic times. The porous zone varies in thickness from about 2 feet to about 20 feet.

Economic Products

The oil produced in the thesis area has a mixed base, is about 33 degrees A. P. I. gravity, and contains about 25 percent gasoline and 15 percent kerosene. The sulphur content averages around 0.18 percent.

The only gas well in the area is the Texas Company's C. H. Thomas No. 5. This well had an initial flow of 200 million cubic feet of gas per day. It is believed that gas is probably from the basal Colorado. The company was preparing to plug and abandon the well, after making 30 gallons of sulphur water per hour at the top of the Madison, when the gas came in.

Summary

The work done on this paper consisted for the most part of assembling material. Very little in the way of written reports had been done on the thesis area; therefore, the great bulk of the information was obtained from the files of the Oil and Gas Commission in Helena, Montana, and some aid was rendered by the Texas Company and the Phillips Petroleum Company. Various maps were consulted to give a prospectus of the area in question. Reports by various authors concerning neighboring producing areas were also consulted. All material is listed in the bibliography and special reference material is also listed separately.

Conclusions

After the gathering of the well data it soon became apparent that the buried hill structure as depicted in the U. S. G. S. map (a portion of which is shown in Figure 1) could not exist. Reference to Plate 3 will readily show that the differences in elevation at the top of the Madison are not of sufficient magnitude to form a structure of the size and proportions shown in Figure 1. The conclusion, then is, that the structure in the area is the same structural terrace as underlies the main Pondera pool a short distance to the northeast.

MONTANA'S ANNUAL PRODUCTION OF PETROLEUM

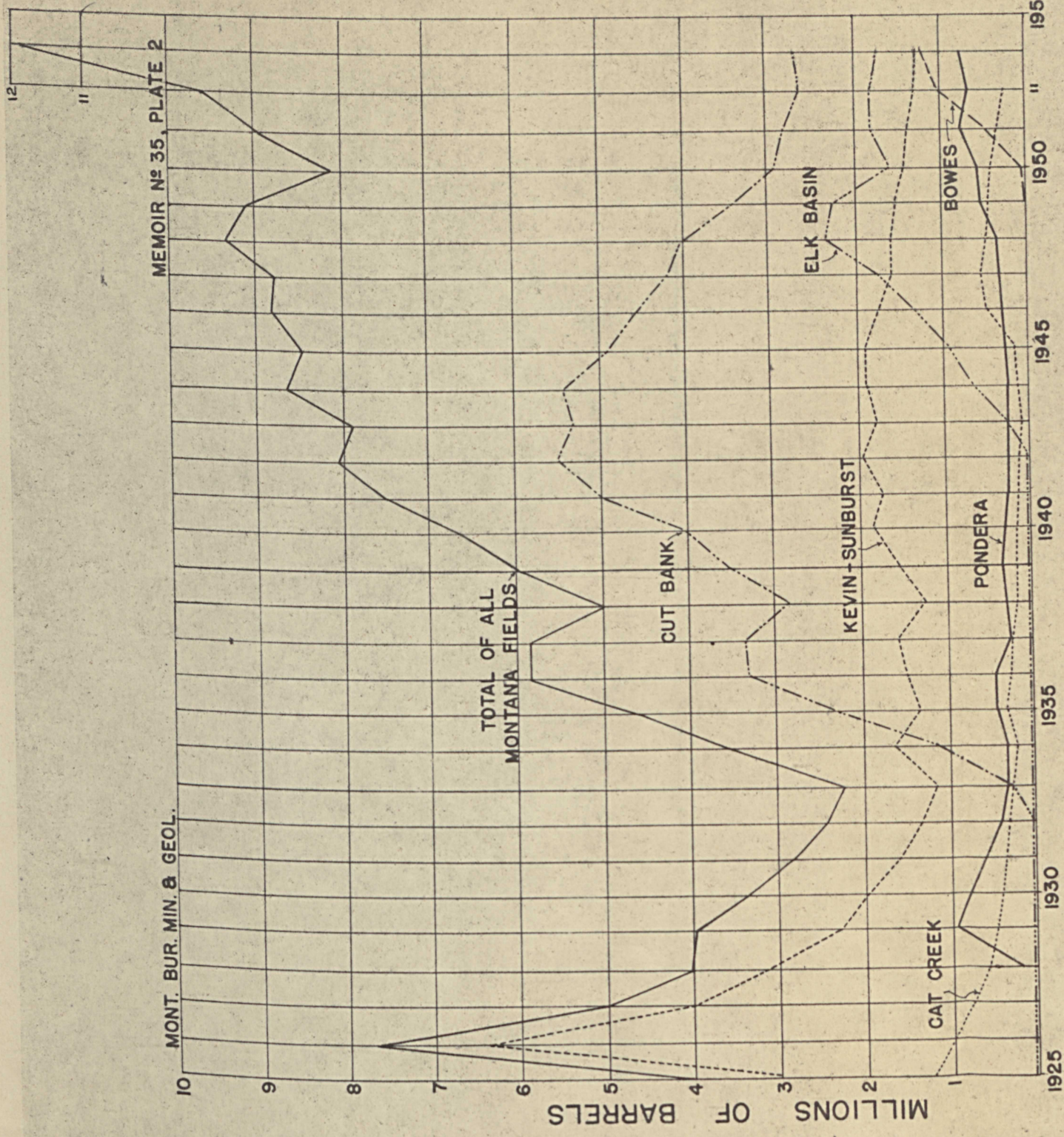


PLATE Nº 10

COMPARISON OF OIL PRODUCTION BY FIELDS.

|| PRIOR TO 1952 - PERRY (1953-PL.2)
AFTER 1952 — MONT. OIL & GAS COMMISSION
(ANNUAL & MONTHLY REPTS.)

* FIGURES FOR 1954 PRODUCTION ▓▓▓ not available.

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WELL LOCATIONS

T. 27 N.--R. 4 W.

File No. 102-B:

HARRIS & BROWN #2 Fuller NE SW NW 29
Elevation: 4036 TD: 2210
Spudded: 7-31-53 Completed: 8-24-53
Result: DRY Status: P&A

Formations:		
0-	18'	Surface Gravel
18-	1570'	Colorado Group
1570-	1860'	Kootenai
1860-	2060'	Sunburst
2060-	2178'	Ellis
2178-	2210'	Madison

File No. 102-A:

HARRIS & BROWN #1 Anna Fuller SW SW NW 29
Elevation: 4036 TD: 2199
Spudded: Completed:
Result: Oil IP 100 B OPD Status: Producing

5-1/2" casing set at 2174' using 30 sax.
Cable tools used from surface to 2199'.

Prod. 1st 24 hrs.: 150 bbls fluid: 88% oil, 1% emulsion, 10% H_2O, 1% sediments.

Formations:		
0-	20'	Surface Gravel
20 -	635'	Colorado Group (dark grey to blue shales with stringers of sand).
635-	745'	Dark grey lime & interbedded shales & sands
745-	880'	Interbedded lst. and dark grey shales.
880-	920'	Grey Shales and silts.
920-	1020'	Interbedded med. grey shales & bentonite.
1020-	1093'	Interbedded grey and dark brown shales & silts.
1095-	1115'	Sst.- fine to med.- hard- compact.
1115-	1555'	Shale, med to dark grey w/ interbedded fine sands and silts.
1555-	1855'	Va riegated red and brown shales w/ tr. silt.
1855-	1925'	Sst- fine to med.- tight.
1925-	1955'	Shale- lite brown to yellow.
1955-	2180'	ELLIS- Shale, med to dark grey to black, calc., very slightly silty.
2180-	2199'	MADISON- dolo., lite grey to brown, sl. calc. w/ stringers of lst.

File No. 61-A

TEXAS COMPANY #1 C.H. Thomas SW SW SW 29
Elevation: 4041 TD: 2193
Result: Oil IP 201 BOPD Status: 10-31-50 Prod.

Casing Record:
95' of 10-3/4"
274' of 10-3/4"
1760' of 8-5/8"
2180' of 7" w/ 21 sax

Formations: Surface- Glacial Drift
35' - Colorado Group
645' - B lackleaf
1475' - Kootenai
1915' - Morrison
2016' - Swift
2090' - Rierdon ELLIS
2192' - Madison

Fiel No. 61-B:

TEXAS COMPANY #2 C.H. Thomas SW N E SW 29
Elevation: 4030 TD: 2231-- PB 2200
Surface: Colorado Well Bot. Fm. Madison
Result: DRY P&A 7-4-51

None 8-5/8" recovered. Of 2193' of 5-1/2"- #17 L.C. slip joint casing-- 1052' recovered. 23 sax placed on bottom at 2193', filled to 2118' or 75' into 5-1/2". Filled w/ mud to 125'-- w/ cement plug placed using 5 sax. Filled to surface w/ mud & cement plug of 1 sax placed & pipe marker erected.

File No. 61-C:

TEXAS COMPANY #3 C.H. Thomas SW NW SW 29
Elevation: 4014 TD: 2174
Surface: Colorado Well Bot. Fm. Madison
Result: DRY P&A

5 sax plug placed at 1680'-- pulled 1617' of 5-1/2"-- hole filled w/ mud to bottom of 10-3/4"--- 10-3/4" pulled-- hole filled w/ mud and gelled to surface-- plug set & marker set therin.

File No. 61-D:

TEXAS COMPANY #4 C.H. Thomas SW SE SW 29
Elevation: 4025 TD: 2186
Surface: Colorado Well Bot Fm. Madison
Result: Oil IP 120 1st 24 hrs (log) 48 BOPD

Formations: 1630' Kootenai
1970' Ellis (Swift)
2182' Madison

File No. 96-A:

PHILLIPS PET. #1 Mamie NW NW NW 35
Elevation: 3945 TD: 2134
Result: 100% Water P&A 10-17-52

Formations:	0- 720'	Surface Gravel	
	720- 1425'	Blackleaf	
	1425- 1865'	Kootenai	
	1865- 1915'	Morrison	
	1915- 2069'	Swift	ELLIS
	2069- 2108'	Rierdon	
	2108- 2134'	Madison lime	

File No. 55-A:

PHILLIPS PET. #1 Freda Johnson NE NW NE 31
Elevation: 4050.8 TD: 2251
Surface: Colorado Well Bot Fm. Top of Madison
Result: Oil IP 54 BO & 100 BWPD
Status: 5-21-50 Producer

Case Record: 90' 8-5/8" w/ 35 sax
2263' 5-1/2" w/ 50 sax
a/w 1000 gals-- 2204-10

Formations:	0- 25'	Surface sands and gravel	
	25- 635'	Colorado	
	635- 1455'	Blackleaf	
	1455- 1920'	Kootenai	
	1920- 2025'	Morrison	
	2025- 2174'	Swift	ELLIS
	2174- 2204'	Rierdon	
	2204- 2251'	Madison	

File No. 55-B:

PHILLIPS PET. #2 Freda Johnson NE NE NW 30
Elevation: 4068 TD: 2255
Spudded: 5-23-50 Completed: 6-10-50
Result: DRY P&A

Formations; (Schlumber Tops)

Surface	Colorado	
680'	Blackleaf	
1500'	Kootenai	
1965'	Morrison	
2028'	Swift	ELLIS
2196'	Rierdon	
2226'	Madison	

Casing: 62' of 8-5/8"

P&A 6-12-50 w/ cement plugs as follows:
0- 20' w/ 4 sax
64- 107' w/ 8 sax
2205- 2255' w/10 sax

File No. 55-C:

PHILLIPS PET. #3 Freda Johnson NE NE NE 31
Elevation: 3043.1 TD: 2203.5
Spudded: 11-15-50 Completed: 12-3-50
Prod. 1st 24 hrs: 80 bbls oil
Result: Swab 60 BOPD
Status: 12-3-50 Producer.
Case Record:
113' of 8-5/8" w/ 100 sax
2190' of 5-1/2" w/ 50 sax
a/w 1000-- 3000 gals.

Formations:
0- 630' Colorado
630- 1450' Blackleaf
1450- 1910' Kootenai
1910- 2020' Morrison
2020- 2166' Swift
2166- 2196' Rierdon
2196- 2203.5 Madison
ELLIS

File No. 55-D:

PHILLIPS PET. #4 Freda Johnson NE SE SE 30
Elevation: 4018 TD: 2176
Result: Oil IP 50 BOPD
Status: 10-11-51 Prod.

Formations:
0- 600' Colorado
600- 1420' Blackleaf
1420- 1880' Kootenai
1880- 2000' Morrison
2000- 2150' Swift
2150- 2178' Rierdon
2178- 2181.5 Madison
ELLIS

File No. 55-E:

PHILLIPS PET. #5 Freda Johnson NE NW NW 32
Elevation: 4026 TD: 2185
Result: Oil IP 100 BOPD
Status: 10-21-51 prod.

Formations:
0- 615' Colorado
615- 1435' Blackleaf
1435- 1895' Kootenai
1895' 2005' Morrison
2005- 2155' Swift
2155- 2185' Rierdon
2185- 2188' Madison
ELLIS

File No. 55-F:
PHILLIPS PET. #6 Freda Johnson NW SW SE 30
Elevation: 4029 TD: 2193.5
Result: Oil IP 20 BOPD
Status: 10-28-52 Prod.

Formations:
0- 730' Surface sand and gravel
730- 1505' Blackleaf
1505- 1935' Kootenai
1935- 1995' Morrison
1995- 2160' Swift
2160- 2190.5 Rierdon
2190.5-2193.5 Madison

File No. 55-H

PHILLIPS PET. #7 Freda Johnson NE NE NW 32
Elevation: 4019 TD: 2185
Surface: Colorado Well Bot Fm: Madison
Result: Oil IP 50 BOPD 0- 2168' Rotary
Status: 1-4-53 prod. 2168- 2185' Churn

Formations:		
	0- 720'	Surface sand and gravel
	720- 1435'	Blackleaf
	1435- 1900'	Kootenai
	1900- 1980'	Morrison
	1980- 2155'	Swift
	2155- 2181.5'	Rierdon
	2181.5- 2185'	Madison lime

File No. 55-G:

PHILLIPS PET. #8 Fredd Johnson SE SE NE 32
Elevation: 4003 TD: 2170
Surface: Colorado Well Bot Fm: Madison
Result: Oil IP 90 BOPD
Status: 12-20-52 prod.

Formations:		
	0- 725'	Surface sands and gravel
	725- 1560'	Blackleaf
	1560- 1925'	Kootenai
	1925- 1970'	Morrison
	1970- 2139'	Swift
	2139- 2167.5'	Rierdon
	2167.5- 2170'	Madison lime

File No. 87-A:

L. W. WINKLER & SON #1 Annie Colgrove NW NW SW 32
Elevation: DF 4030 TD: 2213
Surface: Colorado Well B ot Fm: Madison
Result: DRY P&A
0- 2177 Rotary
2177- 2213 Churn

Formations: 2195- 2213' Madison

File No. ?

DAKMON OIL CO. #1 Colgrove (C NE NE SW 32)?
Elevation: 4016 TD: 2192
1st 24 hrs: 90 bbls fluid-- 50% oil, 50% water.

Formations:		
	0- 25'	gravel
	25- 50'	yel.-grey shale
	50- 60'	Quick sand
	60- 1450'	grey shale & shells
	1450- 2140'	brown,grey shale and shells
	2140- 2190'	black lime
	2190- 2192'	Madison

File No. ?

DAKMON OIL CO. #2 Colgrove (C NW NE SW 32)
Elevation: 4014 TD: 2201
Result: DRY P&A

Hole filled w/ aquejell and cement to top.

Formations: 2195- 2201' Madison

File No. 89-A:

PHILLIPS PET. Teton "A" #1 NE SE SW 30
Elevation: 4044 TD: 2203
Surface: Colorado Well bot Fm: Madison
Spudded: 8-15-52 Completed: 8-27-52
Result: oil IP 192 BOPD
Status: 8-28-52 prod.

Formations:		
	0- 715'	Surface Sand and gravel
	715- 1510'	Bla ckleaf
	1510- 1940'	Kootenai
	1940- 2005'	Swift
	2005- 2166'	Rierdon
	2166- 2201'	Madison

File no. 88-A:

L. W. WINKLER & SON #1 E. Nelson SW NW SE 34
Elevation: 3930 TD: 2104 (To Madison)
Spudded: 5-22-52 Completed: 6-25-52
Result: DRY P&A

Formations:

File No. ?

PHILLIPS PET. Erickson "E" #1 NE NE SE 32
Elevation: 4002 TD: ~~2169.5~~ (2171)
Surface: Colorado Well Bot Fm: Madison
Spudded: 9-9-52 Completed: 9-21-52
Result: oil IP 20 BOPD
Status: 9-23-52 prod.

Formations:		
	0- 735'	Surface sands and gravel
	735- 1305'	Blackleaf
	1305- 1915'	Kootenai
	1915- 1965'	Morrison
	1965- 2139'	Swift
	2139- 2169.5'	Rierdon
	2169.5-2171'	Madison

FORM PO-179-B (8-53) 5M

Approx. Loc'n SW SW ¼ SE ¼ Sec. 29 Twp. 27 N S, Range 4 E W of Mer.

MONTANA County TETON Field or Structure W. PONDERA

THE TEXAS COMPANY Lease C.H. THOMAS Well No. 5

ft. { N or S Line / S of N Line } & ft. { E of W Line / W of E Line } of Elev. Log No.

8-5-53 Date Stopped Drilling 10-8-53 Date at 2088 PB 2168 TD Depth ft. IVF 200 MCFGPD Flowing, Pumper, Gasser or Dry Graphic Log

PRODUCTION RECORD

ted	Bbl/Day	Informant	Remarks

ORMATION RECORD (SKELETON ONLY)

Bottom	Description
	MADISON (EST)
	MADISON TOP

CASING RECORD

Size	Wt.	Set At	Remarks—Cemented or Pulled
5½		2143	w/50
10¾		318	
13⅜		32	

SHOOTING RECORD

Date Shot	Size of Shot	Shot Placed at	Results Obtained

Remarks:

FORM PO-179-B (8-53) 5M

Approx. Loc'n NW NW ¼ SW ¼ Sec. 29 Twp. 27 N S, Range 4 E W of Mer.

MONTANA County TETON Field or Structure W. PONDERA

THE TEXAS COMPANY Lease C.H. THOMAS Well No. 6

ft. { N or S Line / S of N Line } & ft. { E of W Line / W of E Line } of Elev. Log No.

10-4-53 Date Stopped Drilling 12-1-53 Date at 2197 R.B. 2199 T.D. Depth ft. IPP 10 BOPD Flowing, Pumper, Gasser or Dry Graphic Log

PRODUCTION RECORD

ted	Bbl/Day	Informant	Remarks

ORMATION RECORD (SKELETON ONLY)

Bottom	Description
	MADISON

CASING RECORD

Size	Wt.	Set At	Remarks—Cemented or Pulled
10¾		366	w/30
5½		2182	w/70

SHOOTING RECORD

Date Shot	Size of Shot	Shot Placed at	Results Obtained

Remarks:

FORM PO-179-B (8-53) 5M

Approx. Loc'n SW SW ¼ SW ¼ Sec. 29 Twp. 27 N S, Range 4 E W of Mer.

MONTANA County TETON Field or Structure W. PONDERA

THE TEXAS COMPANY Lease C. H. THOMAS Well No. 1

ft. { N or S Line / S of N Line } & ft. { E of W Line / W of E Line } of Elev. 4043 DF Log No.

9-20-50 Date Stopped Drilling 11-1-50 Date at 2193 Depth ft. 120 BO/24 hrs. Flowing, Pumper, Gasser or Dry Graphic Log

PRODUCTION RECORD

sted	Bbl/Day	Informant	Remarks

CASING RECORD

Size	Wt.	Set At	Remarks—Cemented or Pulled
10 3/4		282	NOT CEMENTED
8 5/8		1765	
7		2187	W/215X.

FORMATION RECORD (SKELETON ONLY)

Bottom	Description
	GLACIAL DRFT. (SAMPLE)
	COLORADO Sh.
	BLACK LEAF
	KOOTENAI
	MORRISON
	ELLIS (Swift
	BIERDON
	MADISON

SHOOTING RECORD

Date Shot	Size of Shot	Shot Placed at	Results Obtained

Remarks:

FORM PO-179-B (8-53) 5M

Approx. Loc'n ¼ ¼ Sec. 29 Twp. 27 N S, Range 4 E W of Mer.

MONTANA County TETON Field or Structure W. PONDERA

THE TEXAS COMPANY Lease C. H. THOMAS Well No. 2

1650 ft. { N or S Line / S of N Line } & 990 ft. { E of W Line / W of E Line } of SW 1/4 Elev. 4030 Gr. Log No.

4-5-51 Date Stopped Drilling 5-26-51 Date at 2193 PB. 2221 T.D. Depth ft. IPP 1,39 BO, 644 BWPD Flowing, Pumper, Gasser or Dry Graphic Log

PRODUCTION RECORD

sted	Bbl/Day	Informant	Remarks

CASING RECORD

Size	Wt.	Set At	Remarks—Cemented or Pulled
8 5/8		90	W/50 SX
5 1/2		2182	C/W 60 SX

FORMATION RECORD (SKELETON ONLY)

Bottom	Description
	KOOTENAI (SAMP)
	MORRISON
	SWIFT
	MADISON

SHOOTING RECORD

Date Shot	Size of Shot	Shot Placed at	Results Obtained

Remarks:

FORM PO-179-B (6-53) 5M

Approx. Loc'n SW NW ¼ SW ¼ Sec. 29 Twp. 27 N ~~S~~, Range 4 ~~E~~ W of Mer.

MONTANA County TETON Field or Structure W. PONDERA

r. THE TEXAS COMPANY Lease C.H. THOMAS Well No. 3

ft. { N or S Line / ~~S of N Line~~ } & ft. { E of W Line / ~~W of E Line~~ } of Elev. Log No.

9-9-51 Date Stopped Drilling 12-9-51 Date at 2174 Depth ft. P & A Flowing, Pumper, Gasser or Dry Graphic Log

PRODUCTION RECORD

~~ted~~	Bbl/Day	Informant	Remarks

CASING RECORD

Size	Wt.	Set At	Remarks—Cemented or Pulled
13 3/8		110	
13 3/8		178	
10 3/4		299	W/15
5 1/2		2159	

ORMATION RECORD (SKELETON ONLY)

Bottom	Description
	SUNBURST
	MADISON

SHOOTING RECORD

Date Shot	Size of Shot	Shot Placed at	Results Obtained

Remarks:

FORM PO-179-B (6-53) 5M

Approx. Loc'n SW SE ¼ SW ¼ Sec. 29 Twp. 27 N ~~S~~, Range 4 ~~E~~ W of Mer.

MONTANA County TETON Field or Structure W. PONDERA

. THE TEXAS COMPANY Lease C.H. THOMAS Well No. 4

330 ft. { N or S Line / ~~S of N Line~~ } & 1650 ft. { E of W Line / ~~W of E Line~~ } of Elev. 4031 DF 4028 Gr. Log No.

1-10-52 Date Stopped Drilling 2-26-52 Date at 2186 Depth ft. IPP 120 BOPD Flowing, Pumper, Gasser or Dry Graphic Log

PRODUCTION RECORD

~~ted~~	Bbl/Day	Informant	Remarks

CASING RECORD

Size	Wt.	Set At	Remarks—Cemented or Pulled
10 3/4		303	W/120
5 1/2		2178	W/135

ORMATION RECORD (SKELETON ONLY)

Bottom	Description
	BLACKLEAF
	KOOTENAI
	MORRISON
	SWIFT
	RIERDON
	MADISON

SHOOTING RECORD

Date Shot	Size of Shot	Shot Placed at	Results Obtained

Remarks:

GARDING--- May 1954 S.O. 23260

LANE WELLS RADIOACTIVITY LOG

COMPANY

FILE NO.

Location of Well

NE NW NE

SEC. 31-27N-4W

COMPANY: PHILLIPS PETROLEUM COMPANY

WELL: FREDA NO. 1

FIELD: WILDCAT S.W. Ext. Pondera

COUNTY: TETON STATE: MONT.

LOCATION: NE NW NE

SEC. 31-27N-4W

COMPANY PHILLIPS PETROLEUM COMPANY
WELL FREDA No. 1
FIELD WILDCAT
COUNTY TETON STATE MONT.
LOCATION NE NW NE
SEC. 31-27N-4W

LOG MEAS. FROM	DERRICK FLOOR	ELEV. 4050.8
DRLG. MEAS. FROM	DERRICK FLOOR	ELEV. 4050.8
PERM. DATUM	GROUND LEVEL	ELEV. 4046.8

	GAMMA RAY	NEUTRON
TYPE OF LOG		
RUN NO.	1	1
DATE	3-16-50	3-16-50
TOTAL DEPTH (DRILLER) DRILL PIPE	2249	2249
EFFECTIVE DEPTH (DRILLER)	2249	2249
TOP OF LOGGED INTERVAL	0	0
BOTTOM OF LOGGED INTERVAL	2245	2245
TYPE OF FLUID IN HOLE	WATER BASE MUD	
FLUID LEVEL	FULL	FULL
MAXIMUM RECORDED TEMP.		
NEUTRON SOURCE STRENGTH & TYPE		60CN
SOURCE SPACING — IN.		8.25"
LENGTH OF MEASURING DEVICE — IN.	36"	9"
O.D. OF INSTRUMENT — IN.	3 5/8"	3 5/8"
TIME CONSTANT — SECONDS	H	E
LOGGING SPEED FT. MIN.	30'	30'
STATISTICAL VARIATION — IN.	1/4"	1/4"
SENSITIVITY REFERENCE	274	275
RECORDED BY	HAWTHORNE	HAWTHORNE
WITNESSED BY	NORDQUIST	NORDQUIST

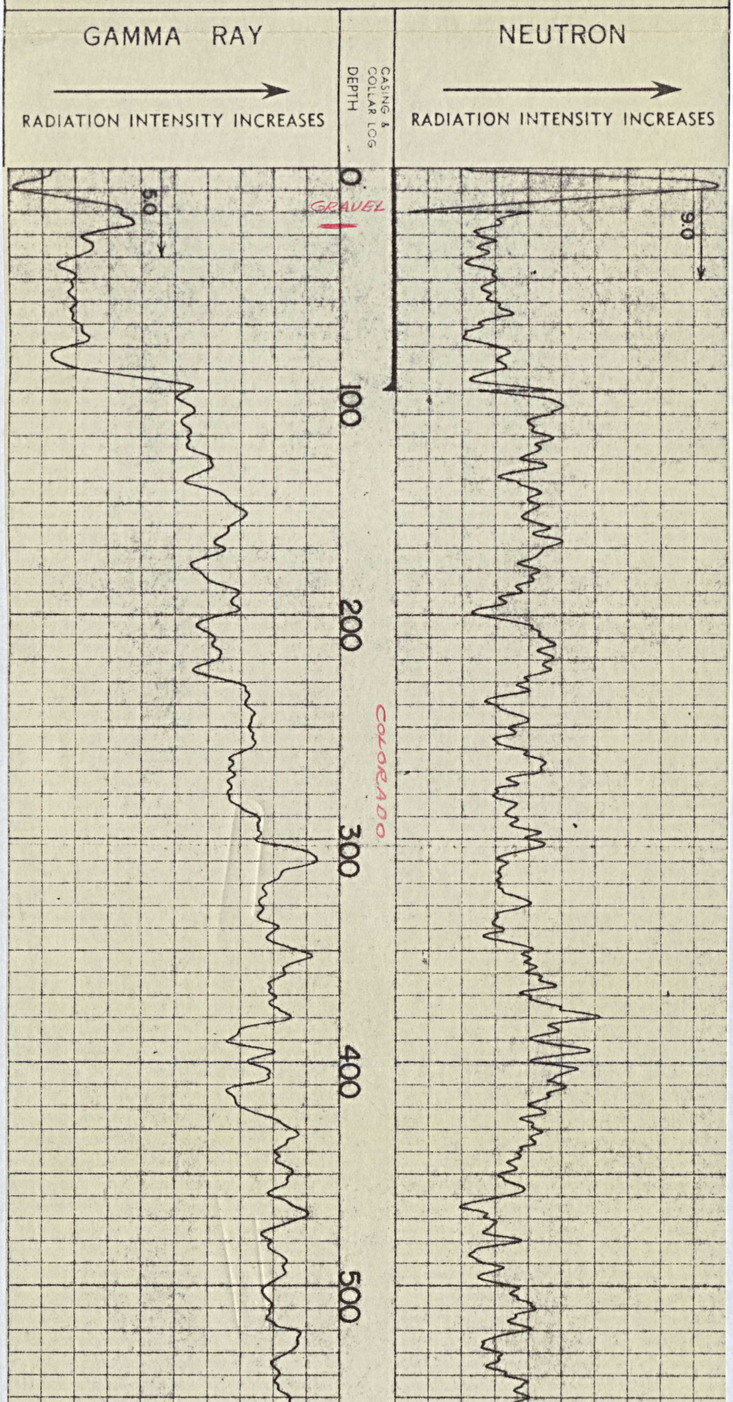
CASING RECORD

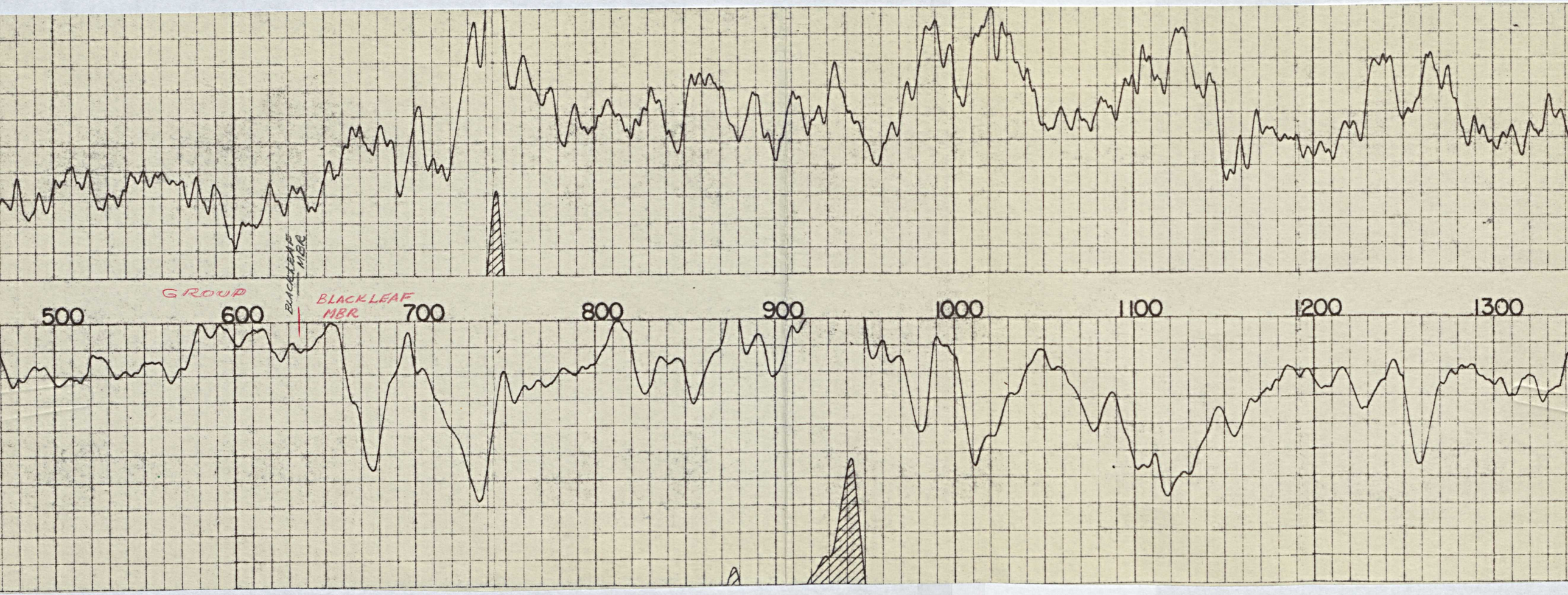
RUN NO.	SIZE—IN.	WT.—LB.	INTERVAL
1	8 5/8		0 TO 96
			TO
			TO
			TO
			TO

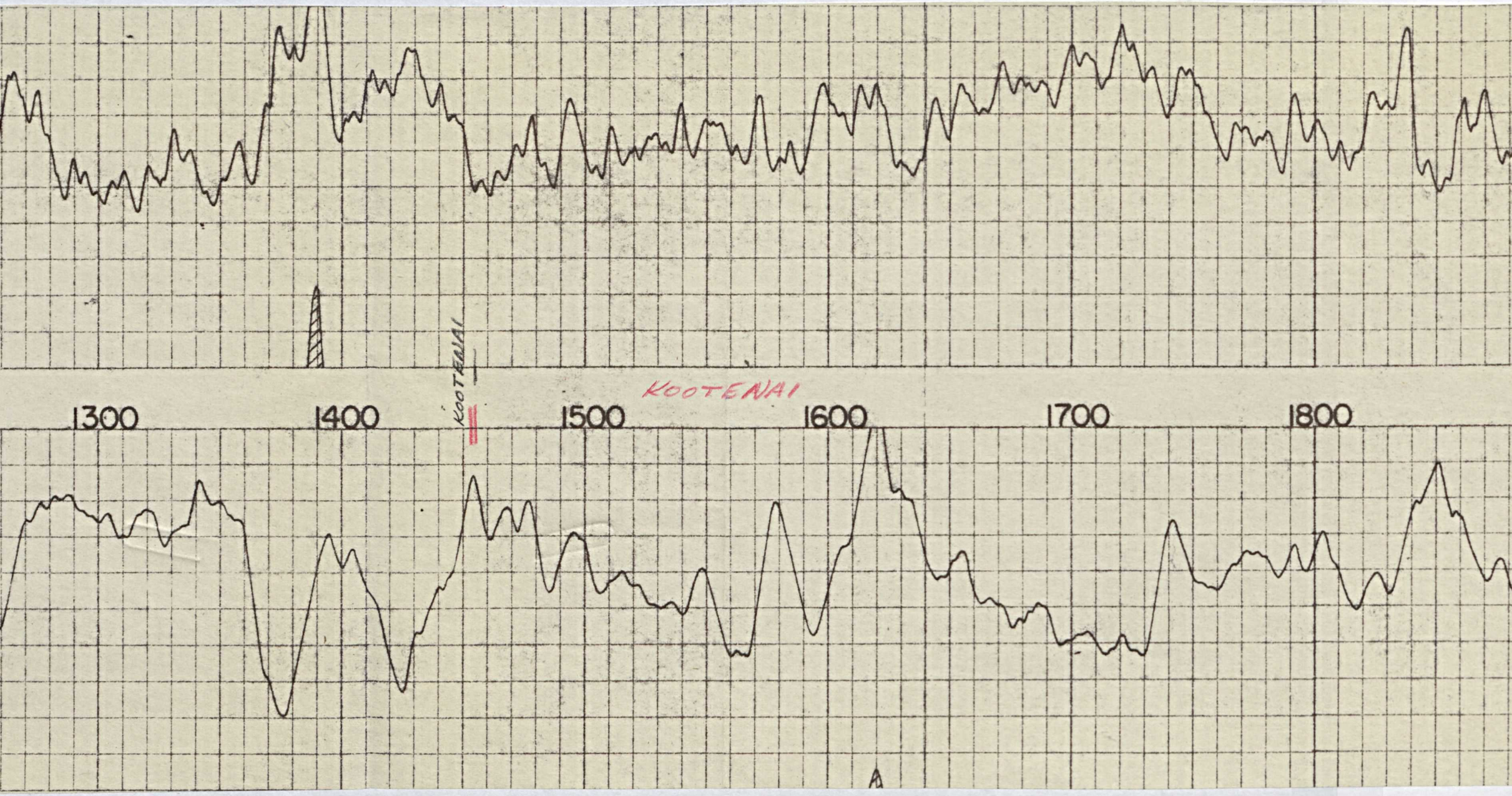
OPEN (BORE) HOLE RECORD

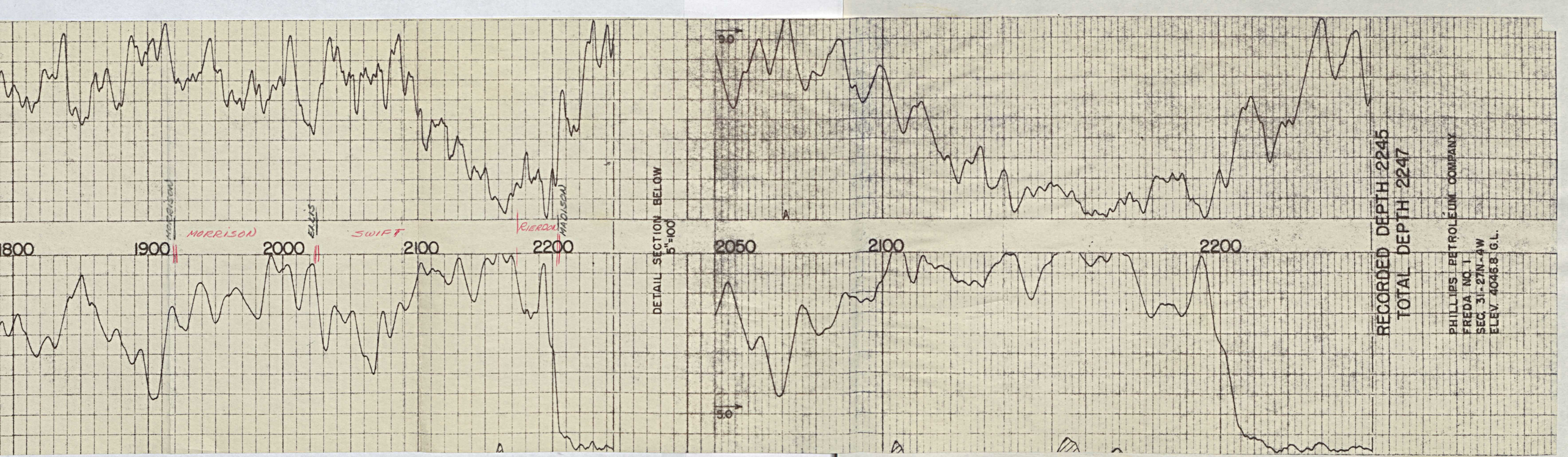
BIT SIZE—IN.	INTERVAL
7 3/8	96 TO 2249
	TO
	TO
	TO
	TO

REMARKS OR OTHER DATA




GROUP
BLACKLEAF MBR
BLACKLEAF MBR
500
600
700
800
900
1000
1100
1200
1300


KOOTENAI
KOOTENAI
1300
1400
1500
1600
1700
1800


1800
1900
2000
2100
2200
MORRISON
ELLIS
SWIFT
RIERDON
MADISON
DETAIL SECTION BELOW
5"=100'
9.0
5.0
2050
2100
2200
RECORDED DEPTH 2245
TOTAL DEPTH 2247
PHILLIPS PETROLEUM COMPANY
FREDA NO. 1
SEC. 31-27N-4W
ELEV. 4046.8 G.L.